Request for Proposal
W912ER21R0001

Specifications
for

P964 Shore to Ship Utilities

Naval Support Activity (NSA), Bahrain

Volume 2
Divisions 01 - 22

US Army Corps
of Engineers
Middle East District

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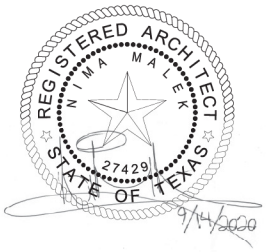
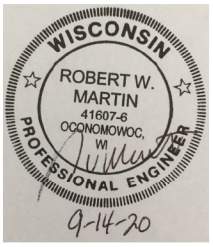
Request for Proposal
W912ER21R0001

Specification Stamp Page
for

P964 Shore to Ship Utilities

Naval Support Activity (NSA), Bahrain





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SECTION 01 11 00

SUMMARY OF WORK
08/15

PART 1 GENERAL

The P964 Shore to Ship Utilities project will construct adequately sized and efficiently configured shore-to-ship based utility systems on NSA II. These dedicated shore-to-ship based utility systems will support forward deployed littoral combat ship (LCS) surface combatants, and be able to service compatible homeported, forward deployed, rotationally deployed, and visiting U.S. ships on extended leave at NSA Bahrain.

This project constructs hotel service stations along the waterfront for shore-to-ship utility connections.

Constructs an electrical distribution system, pad mounted switchgear and frequency converters along the waterfront to provide shore-to-ship electrical utility services for ship connections.

Constructs a single story addition to the existing Consolidated Utility Building. The addition will provide space for the addition of a third reverse osmosis plant and chemical storage.

Constructs a single story high-bay storage facility for the utility system. The building consists of open storage with racks for the efficient storage of power cable spools, piping, hoses, tools and equipment.

Architectural systems include concrete masonry unit (CMU) walls, standing seam metal roof, insulated metal panel siding, overhead doors, translucent panels for daylighting.

Paving and site improvements include bases and sub-bases, pavement, roadways, equipment pads for frequency converters and generator, screen walls around the backup generator, equipment sunshades over the frequency converters and an above ground fuel tank.

Electrical utilities include automatic transfer switch with weather enclosure, transformers, diesel backup generator with fuel storage, telecommunications and advance metering.

Mechanical utilities will include potable water distribution system, reverse osmosis package water treatment skid, sanitary sewer distribution systems with pump stations, industrial waste ship hotel connections and advanced metering.

This project also includes selective demolition within the existing consolidated utility building.

This work includes the supply and installation of Naval Support Activity II (NSA) Reverse Osmosis (RO) potable water treatment system, in accordance with Section 01 80 10 SUMMARY OF WORK FOR P964 WATER TREATMENT EQUIPMENT EXPANSION.

The Contractor shall prepare a construction phasing plan in accordance with Section 01 15 00.12 10 SUPPLEMENTARY REQUIREMENTS, 1.5 CONSTRUCTION

PHASING PLAN.

The Contractor shall provide pricing as an executable bid option to install the required hardware and make the Base electrical interconnection between NSA I and NSA II, in accordance with contract documents.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS
11/11

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROECDURES:

SD-01 Preconstruction Submittals

List of Contact Personnel; G M/R

Special Scheduling Requirements; G R

SD-06 Test Reports

Supporting Documentationfor new utility lines; G M

1.2 SPECIAL SCHEDULING REQUIREMENTS

a. The Contractor must conduct his operations so as to cause the least possible interference with normal operations.

b. Permission to interrupt any roads and/or utility service must be requested in writing a minimum of 30 calendar days prior to the desired date of interruption. Contractor shall also include in the request, any needed traffic control and/or repair plans.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Subcontractors and Personnel Contacts

Provide a list of contact personnel of the Contractor and subcontractors including telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.3.2 No Smoking Policy

Smoking, including smokeless tobacco and e-cigarettes, is prohibited within and outside of all buildings on installation, except in designated smoking areas. This applies to existing buildings, buildings under construction and buildings under renovation. Contractor shall adhere to all NSA's smoking policies. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas.

1.3.3 Working Hours

Regular duty hours consist of a 8.5 hour period, Sunday through Thursday, excluding Government holidays. Government of Bahrain Summer Work Hour

restrictions will be followed.

1.3.4 Work Outside Regular Hours

If the Contractor desires to carry on work outside regular duty hours, or on holidays (including the following U.S. holidays: New Year's Day, Martin Luther King Jr's Birthday, George Washington's Birthday, Memorial Day, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving and Christmas), he shall submit a written request via serial letter to the Contracting Officer. Written request shall contain, at a minimum, why work is to be performed, work activities, and the safety, quality control and superintendence controls provided. The Contractor shall allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. At night, exterior lighting shall be provided in conformance with EM-385-1-1 entitled "Safety and Health Requirements Manual". The following pertains to this contract:

1.3.5 Occupied Areas and Existing Facilities

The Contractor may be working around occupied areas and existing facilities. Do not enter these areas or facilities without prior approval of the Contracting Officer.

1.3.6 Utility Cutovers and Interruptions

a. Contractor shall install all utilities and make all connections. The Contractor shall perform final terminations under the observation of the PWD BOSC contractor when available.

b. Ensure that new utility lines are complete and servicable. Contractor is required to perform any required tests, disinfections, or other requirements and submit supporting documentation in coordination with paragraph 1.1 Submittals of this specification section.

c. Interruption to telephone service, electric service, and fire alarm are considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

d. Operation of Station Utilities: The Contractor must not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, electrical, and steam services. The Government will operate the control devices as required for normal conduct of the work. All outage requests will comply with paragraph 1.2b. above The Contractor must notify the Contracting Officer giving 30 days minimum notice when such operation is required.

1.4 MILITARY BASE SECURITY REQUIREMENTS

1.4.1 Requirements

The Base Security Office maintains the ultimate authority for establishing, monitoring, and enforcing security requirements. All contractor, subcontractor, or vendor personnel and vehicles at any tier working at any location on the project are subject to a thorough search upon entering, departing, or at any time deemed necessary by Base Security Personnel. The Contractor shall be responsible for compliance with all laws, regulations and policies of the Government of Bahrain and all Base Security requirements. The Base Security Officer will not approve access for any worker, to any part of the project, when laws, regulations or

policies of the Government of Bahrain have not first been met. The Government reserves the right to deny access or to require the contractor to remove any personnel or equipment deemed to be a threat to the security of the Base or Base personnel. The Contractor shall work through the Contracting Officer to assure that base security regulations are followed.

1.4.2 Security Area

All work under this contract will be confined to project limits unless approved in advance by the Contracting Officer. Access to the site will be coordinated with US Navy Base Security personnel. Minimum requirements for Contractor entry and operations are described below.

The Contractor will have the primary responsibility for implementation and enforcement of the security for all contractor personnel and equipment in the project limits.

1.4.2.1 Primary Access to the Project Area

Contractor's primary access to the project area for all personnel, vehicles, equipment and materials will be limited to the project area gate. The Contractor shall be responsible for developing and implementing Security and Access Procedures in compliance with existing requirements of Bahrain Defense Force and US Navy Security. Contractor shall be accountable for the amount of badge fees as determined by the Host Nation.

1.4.2.2 Identification of Employees in the NSA Area

At least thirty (30) days prior to requiring access, the Contractor shall submit to the Bahrain Resident Office a BASE ACCESS REQUEST for each individual. Note that there may be fees and longer lead times required for certain types of badges.

The request form must be typed and completely filled out. Any request form with empty fields, missing credentials or illegibly written words/numbers will be rejected and access denied until the application is resubmitted correctly. Request form to be submitted must include color copies of identification documents such as valid passport, Central Population Registry (CPR) card, Resident permit/visa and driver's license. For the document to be valid, it must be current (not expired), accurately depict the document holder, and must not show signs of tampering or alteration. Employees shall wear hard hats and coveralls of a distinct color for the contractor's personnel and for each subcontractor's personnel. The coveralls shall have markings on the back clearly identifying the company for whom the employee works.

1.4.2.3 Identification of Vehicles and Equipment in the Project Area

All Contractor vehicles and equipment entering the project area must be listed on the US Navy Vehicle Access List. The Contractor shall provide a list of all vehicles that require access to the project area. This access list shall include the type of equipment, make and model, registration number, company name of owner. The current access list will be provided through the Contracting Officer to the Base Security Officer on a weekly basis. The Contractor shall plan his vehicle and equipment requirements such that the access list will contain all those vehicles and equipment that will need access to the project area for completion of the particular work item being performed. All Contractor vehicles and equipment entering will be subject to a thorough inspection by Base Security personnel. No

vehicle will be left unattended in the project area at any time.

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1.4.3 Contractor Trusted Agents

The contractor will appoint an individual to act as its Trusted Agent throughout the duration of this contract. The Trusted Agent's primary function will be to coordinate all issues relative to access to the project area, to establish and maintain employee and vehicle access lists, to coordinate the entry of escorted visitors and materials to the Security Areas, and to generally represent the contractor's interest in dealing with the Contracting Officer and the Base Security Personnel. This individual shall be capable of clearly communicating orally and in writing with Base Security personnel. The ability to communicate in other languages than English will be beneficial as well. The Trusted Agent will be subject to the approval of the Base Security Officer and can be removed from the position at anytime at the request of the Base Security Officer. The Trusted Agent will work at the contractor's office located at the project area. At the start of construction the Trusted Agent, the Contracting Officer and the Base Security Officer shall meet to discuss all details of the Base Security requirements, to reach an understanding of the Trusted Agent's duties and other operational relationships.

1.4.4 Access to Operational Areas

Contractor personnel are expressly prohibited from entering operational buildings or areas without the specific authorization of the Base Security Office. Necessary access to operational buildings or areas shall be coordinated through the Contracting Officer and approved by the Base Security Officer a minimum of thirty (3)days before access is required.

1.5 MILITARY BASE RULES AND REGULATIONS

The Contractor and his employees and subcontractors shall become familiar with and obey all Base rules and regulations including fire, traffic and security regulations. All personnel employed on the Base shall keep within the limits of the work (and avenues of ingress and egress), and shall not enter any Restricted Areas unless required to do so and prior clearance for such entry is obtained. The Contractor's equipment shall be conspicuously marked for identification.

1.6 INSTALLATION ACCESS

Work under this contract will be performed at a location with security and access control procedures. Compliance with base pass and access procedures is the sole responsibility of the Contractor, and is required to be accomplished prior to initiation of the process for gaining access to controlled sites. Contractor shall be responsible for determining the nature and amount of any fees required. Contractor is responsible for all workers granted access pursuant to work under this contract.

a. Other Data: Contractor shall provide additional data, as required and not specifically indicated above, to secure all required passes for where work is required to be performed.

b. Compliance with Revised Requirements: The government may revise requirements and procedures for obtaining passes and/or access to the

site of work at any time during the life of the contract. Contractor shall comply with all such requirements, as directed by the Contracting Officer.

c. Contractor shall employ an acceptable system for accountability and control of all compound passes/access badges issued to him. Passes/Access Badges shall be returned to the Government as soon as they are no longer required.

1.7 CONTRACTOR TRANSPORTATION AND CUSTOMS CLEARANCE

All materials and equipment which are to be incorporated into the project, or are to be used in support of this contract, may be shipped free of duty, if the following actions are taken:

1.7.1 Shipments of Materials

All shipments of materials into the country for use in performance of work under this contract and supplies or services necessary for support of the Contractor's personnel shall be addressed to the shipping address furnished to the Contractor by the Contracting Officer. Address will be furnished upon request by the Contractor.

1.7.2 Contractor's Responsibilities

The following items are the sole responsibility of the Contractor to investigate, estimate as to cost, and assume the risk, as normally encountered by Contractors. The Contractor shall be responsible for determining the effect of the following on his own cost of performance of the contract and for including sufficient amount in the contract price:

a. Payment of Value Added Tax (VAT).

b. Official language and type of accounts required to satisfy the officials of the Local Government.

c. Entry and exit visas, residence permits, and residence laws applicable to aliens. This includes any special requirements of the Host Government, including those required by local Labor Offices, which the Contractor may have to fulfill before an application for a regular block of visas will be accepted.

d. Passports, health and immunization certificates, and quarantine clearance.

e. Compliance with local labor and insurance laws, including payment of employer's share of contribution, collecting balance from employee and paying into insurance funds.

f. Strikes, demonstrations and work stoppage.

g. Collection through withholding and payment to local Government, of any Host Country income tax on employees subject to tax.

h. Arranging to perform work in the Host Country, to import personnel, to employ non-indigenous labor, to receive payments and to remove such funds from the country.

i. Operating under local laws, practices, customs and controls,

and with local unions, in connection with hiring and firing, mandatory wage scales, vacation pay, severance pay, overtime, holiday pay, 7th day of rest, legal notice or pay in lieu thereof for dismissal of employees, slowdown and curtailed schedules during religious holidays and ratio of local labor employed in comparison to others.

j. Possibility of claims in local bureaus, litigation in local courts, or attachment of local bank accounts.

k. Compliance with workmen's compensation laws and contributions into funds. Provisions of necessary medical service for Contractor employees.

l. Special license required by the local Government for setting up and operating any manufacturing plant in the Host Country, e.g. concrete batching, precast concrete, concrete blocks, etc.

m. Sales within the host country of Contractor-owned materials, and equipment.

n. Special licenses for physicians, mechanics, tradesmen, drivers, etc.

o. Identification and/or registration with local police of imported personnel.

p. Stamp tax on documents, payments and payrolls.

q. Base passes for permanent staff, day laborers, motor vehicles, etc.

r. Compliance with all customs and import rules, regulations and restrictions, including, but not limited to, local purchase requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 15 00.12 10

SUPPLEMENTARY REQUIREMENTS
10/15

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROECDURES:

SD-01 Preconstruction Submittals

Requests for Digging Permits; G R

Construction Phasing Plan; G R

Proposed Means of Providing Project Security; G R

Accident Prevention Plan (APP); G R

Requests for Hot Work Permits; G R

SD-07 Certificates

Certificates Of Compliance

SD-11 Closeout Submittals

Inventory of all excess supplies, materials and equipment; G R

1.2 MEETING MINUTES

The Contractor shall be responsible for the preparation of minutes of all meetings specified in the contract documents. Unless otherwise specified, these minutes shall be prepared within two (2) working days after meeting and signed by both the Contractor and Contracting Officer. Contractor shall provide signed copies to all attendees.

1.3 ENGLISH SPEAKING REPRESENTATIVE

At all times when any performance of the work at any site is being conducted by any employee of the Contractor or its subcontractors, suppliers, or vendors at any tier, the Contractor shall have a representative present at each site who has the capability of receiving instructions in the English language, fluently speaking the English language and explaining the work operations to persons performing the work in the language that those performing the work are capable of understanding. The Contracting Officer shall have the right to determine whether the proposed representative has sufficient technical and lingual capabilities, and the Contractor shall immediately replace any individual not acceptable to the Contracting Officer.

1.4 DIGGING PERMITS

1.4.1 Requirements for Digging Permits

Prior to the start of any work activity which requires excavation, the Contractor shall obtain a digging permit.

1.4.2 Requests for Digging Permits

Requests for Digging Permits shall be submitted through the Contracting Officer to the Public Works Department (PWD) a minimum of thirty (30) days prior to the start of the work activity covered by the permit. The request for a Digging Permit shall include a narrative description of the work to be performed and a detailed map of the area of the excavation clearly marking the location of all known utilities or other obstructions. A repair plan shall also be included containing the approved submittals (i.e. any material as required by the appropriate specifications under which the digging permit is supporting) for any repair material. If the work activity covered by the Digging Permit request also requires a utility outage, a separate request for the outage shall be submitted.

1.4.3 Preparation of Requests for Digging Permits

Prior to submitting a request for a Digging Permit, the Contractor shall carefully review the area to be excavated to determine the location of existing utilities and other obstructions. The Contractor will review available drawings and will conduct a visual inspection of the site. The Contractor will utilize underground utility detecting devices such as metal and cable detectors to determine the location of existing utilities. All utility lines found shall be clearly flagged or marked and the location of the utility shall be shown on the drawing to be submitted with the request for Digging Permit.

1.4.4 Existing Underground Utilities

The Contractor is provided notice that existing utilities are present in the construction area which may not be shown, or are inaccurately shown, on the base as-built drawings and the contract drawings. The Contractor shall exercise utmost care in researching locations of existing utilities and reducing damage to existing utilities. Any utilities damaged by the Contractor shall be promptly repaired by the Contractor. The Contracting Officer will review and approve any proposed repairs. Any damage to existing utilities will be immediately reported to the Contracting Officer and the PWD.

1.4.5 Use of Underground Utility Detecting Device

Prior to any excavation, a metal and/or cable detecting device shall be used along the route of the excavation. All underground utilities discovered by this method will be flagged a minimum distance of one-half (1/2) meter on each side of the location.

1.4.6 Hand Excavation

Hand excavation methods and special supervisory care shall be used between any flagged markers, in areas of known or suspected hazards, and in areas known or suspected to have multiple and/or concentrated utility lines or connections.

1.5 CONSTRUCTION PHASING PLAN

The Contractor shall prepare a construction phasing plan meeting all the RFP requirements and based on the Construction Segments as shown in the RFP drawings. The Contractor shall coordinate the construction sequencing with the COR, and the Base Engineer, with regards to work sequencing, road closures, laydown areas, haul routes, etc., prior to submission of the Phasing Plan. The Phasing Plan shall show the detailed plan for accomplishing work, major work activity durations and start and finish milestones for each phase, intended work hours, personnel, equipment, traffic hauling patterns to, and around the work site, Foreign Object Damage prevention, mobilization and demobilization, and Security. This plan shall be submitted for approval within 10 calendar days of NTP, and will be updated from time to time as operational requirements demand.

1.6 RESPONSIBILITY FOR PHYSICAL SECURITY

Prior to mobilization, the Contractor shall submit his proposed means of providing project security to prevent unauthorized access to equipment, facilities, materials and documents, and to safeguard them against sabotage, damage, and theft. The Contractor shall be responsible for physical security of all materials, supplies, and equipment of every description, including property which may be Government-furnished or owned, for all areas occupied jointly by the Contractor and the Government, as well as for all work performed.

1.7 CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in accordance with Section 01 33 00 SUBMITTAL PROCEDURES . Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company involved and shall contain the name and address of the Contractor, the project name and location, description and the quantity of the items involved, and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material.

1.8 ACCIDENT PREVENTION

The Contractor shall comply with all applicable Host Country laws and with such additional measures as the Contracting Officer may find necessary in accordance with CONTRACT CLAUSE 52.236-13 entitled ACCIDENT PREVENTION (NOV 1991). Applicable provisions of the Corps of Engineers manual entitled Safety and Health Requirements Manual EM 385-1-1, will be applied to all work under this contract. The referenced manual may be obtained by copying the below into the URL address:

https://www.usace.army.mil/Missions/Safety-and-Occupational-Health/Safety-and-Health-Requirements-Manual/

1.8.1 Accident Prevention Plan (APP)

Submit the APP to the Contracting Officer 30 calendar days prior to the date of the preconstruction conference for acceptance by the Contracting Officer. The Contractor shall not commence physical work at the site until

the Accident Prevention Plan (APP) has been reviewed and accepted by the Contracting Officer or his authorized representative. The APP shall meet the requirements listed in Appendix "A" of EM385-1-1.

The Activity Hazard Analysis (AHA) is a method in which those hazards likely to cause a serious injury or fatality are analyzed for each phase of operations. Corrective action is planned in advance which will eliminate the hazards. An analysis is required for each specific Definable Feature of Work (DFOW) and shall be submitted utilizing the Resident Management System (RMS) rather than presenting the complete analysis. If the plan is to be presented in phases, a proposed outline for future phases must be submitted as a part of the initial Accident Prevention Plan submittal. Accident Prevention Plans will be reviewed for timeliness and adequacy at least monthly with a signature sheet signed and dated documenting that these reviews took place.

Copy of company policy statement of Accident Prevention and any other guidance as required by EM 385-1-1, Appendix A.

1.8.2 Ground Fault Circuit Interrupter (GFCI) Requirement - Overseas Construction

The Corps of Engineers Health and Safety Manual, EM 385-1-1, section 11.C.05.a. states: "The GFCI device shall be calibrated to trip within the threshold values of 5 ma +/- 1 ma as specified in Underwriters Laboratory (UL) Standard 943." A variance from USACE has been granted allowing 10 ma, in lieu of 5 ma, for overseas activities that use 220 Volts(V)/50 hertz(hz) electrical power.

1.8.3 Temporary Power - Electrical Distribution Boxes

EM 385-1-1 section 11.A.01.a. states "All electrical wiring and equipment shall be a type listed by a nationally recognized testing laboratory for the specific application for which it is to be used." This includes temporary electrical distribution boxes. Locally manufactured electrical boxes will not be allowed. Only manufactured electrical distribution boxes that meet the European CE requirements, with 10 ma CE type GFCIs installed shall be allowed.

Contractors shall:

a. Make no modifications that might void any CE or manufacturer certification.

b. Test the installed systems to demonstrate that they operate properly and provide the 10 ma earth leakage protection.

c. Ensure GFCIs will have an integral push-to-test function. The testing shall be performed on a regular basis.

d. Check that proper grounding is checked regularly and flexible cords, connectors, and sockets inspected before each use.

1.8.4 Reinforcement Caps

All rebar and other protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement. The guarding shall meet Code of Regulations, Title 8, Section 344.90 California Impalement Protection. Each protective cover shall be

marked with the following information:

(1) Model Number or Trademark.
(2) California Approval Number as issued pursuant to Sections 1712 and 1505 of the above listed Code.
(3) Size(s) designation.

1.9 LOCALLY AVAILABLE SERVICE FOR EQUIPMENT

All equipment furnished under this contract, regardless of country of manufacture or purchase, must have in-country service availability. In the event that the Contractor proposed to provide equipment for which in-country service is not available, the Contractor must provide written justification for the Contracting Officer's approval. This justification shall be submitted for each product or material for which a waiver is sought concurrently with the submittal required by the Technical Provisions. Submission of group or "blanket" waivers is unacceptable.

1.10 PHYSICAL CONDITIONS

The indications of physical conditions on the drawings and in the specifications are the result of site investigations. Exploration logs (FOR INFORMATION ONLY) are presented as an exhibit to this section.

1.11 STANDARDIZATION

Where two or more items of the same type or class of equipment furnished in this project are required, the units shall be products of the same manufacturer and shall be interchangeable when of the same size, capacity, performance characteristics, and rating. The only exception to this requirement is where the items are interchangeable due to conformance with industry standards (valves, fittings, etc.), they need not be by the same manufacturer. This requirement applies to all manufactured items in the project which normally require repair or replacement during the life of the equipment.

1.12 ON-BASE PHOTOGRAPHY PROHIBITION

The Contractor shall not engage in any form of photography without prior written approval from the Naval Security Force (NSF) in the form of an approved camera pass.

1.13 PUBLIC RELEASE OF INFORMATION

1.13.1 Prohibition

There shall be no public release of information or photographs concerning any aspect of the materials or services relating to this bid, contract, purchase order, or other documents resulting therefrom without the prior written approval of the Contracting Officer.

1.13.2 Subcontract and Purchase Orders

The Contractor agrees to insert the substance of this clause in all purchase orders and subcontract agreements issued under this contract.

1.14 CUSTOM EXEMPT CONTRACT

The Contractor shall furnish to the Contracting Officer, prior to

completion of this contract, a consolidated inventory of all inventory of all excess supplies, materials and equipment imported duty free for use under this contract. The Contractor shall either pay required duties on the excesses, re-export the excesses, or the excesses shall become the property of the Government.

1.15 COMPLIANCE WITH HOST COUNTRY RULES AND CUSTOMS

The laws of Host Country may prohibit access to certain areas of the country which are under military control. The Contractor shall furnish the Contracting Officer the names of personnel, type, and amounts of equipment, dates and length of time required at the site, and the purpose of entering the host country. It is understood that areas to which rights of entry are provided by the Host Government are to be used only for work carried out under the contract and no destruction or damages shall be caused, except through normal usage, without concurrence of the Host Government.

1.16 RADIO TRANSMITTER RESTRICTIONS

To preclude accidental actuation of sensitive electronic equipment, the Contractor shall not use radio transmitting equipment without prior approval of the Contracting Officer.

1.17 BASE HOT WORK PERMITS

1.17.1 Requirement for Hot Work Permits

Prior to the start of a work activity including hot work (welding, burning, etc.) or the operating of other flame producing devices, the Contractor shall obtain a Hot Work Permit.

1.17.2 Requests for Hot Work Permits

Requests for Hot Work Permits go through the Base Fire Department a minimum of 15 days in advance prior to the start of the work activity covered by the permit. Contractor shall submit such request to the Site Safety and Health Officer (SSHO). The request for a Hot Work Permit shall include a narrative description of the work to be accomplished, a list of equipment to be used, and a description of special safety precautions that the Contractor will put in place during the work to assure compliance with EM 385-1-1 and Base Fire Regulations.

1.17.3 Preparatory Inspections and Inspection of Equipment

During the Preparatory Inspection for any work activity including hot work, the Hot Work Permit shall be reviewed. During the Preparatory inspection, all hot equipment and safety equipment shall be checked to assure that it is in proper working order. Safety equipment required by the Hot Work Permit shall be checked at the beginning of each shift to assure that it is in proper working order.

1.18 EXHIBIT

Exhibit A - Exploration Data

-- End of Section --

Exhibit A

Exploration Data

Provided in Separate File

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SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS
08/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

15 CFR 772	Definition of Terms
15 CFR 773	Special Licensing Procedures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Progress and Completion Pictures; G M/R

1.3 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color minimum resolution in JPEG file format showing the sequence and progress of work. Take a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten views from points located by the Contracting Officer's Representative. Submit with the monthly invoice two sets of digital photographs, each set on a separate compact disc (CD) or data versatile disc (DVD), cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Provide photographs for each month in a separate monthly directory and name each file to indicate its location on the view location sketch. Also provide the view location sketch on the CD or DVD as a digital file. Include a date designator in file names. Cross reference submittals in the appropriate daily report. Photographs provided are for unrestricted use by the Government.

1.4 SUPERVISION

1.4.1 Minimum Communication Requirements

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of contract work. In addition, if a Quality Control (QC) representative is required on the contract, then that individual must also have fluent English communication skills.

1.4.2 Superintendent Qualifications

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

The project superintendent must have a minimum of 10 years experience in construction with at least 5 of those years as a superintendent on projects similar in size and complexity. The individual must be familiar with the requirements of EM 385-1-1 and have experience in the areas of hazard identification and safety compliance. The individual must be capable of interpreting a critical path schedule and construction drawings. The qualification requirements for the alternate superintendent are the same as for the project superintendent. The Contracting Officer may request proof of the superintendent's qualifications at any point in the project if the performance of the superintendent is in question.

1.4.2.1 Duties

The project superintendent is primarily responsible for managing and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend Red Zone meetings, partnering meetings, and quality control meetings. The superintendent or qualified alternative must be on-site at all times during the performance of this contract until the work is completed and accepted.

1.4.3 Project Manager

Assign a Project Manager with the responsibility for the overall management of the project. The Contracting Officer may request proof of the Project Manager's qualifications at any point in the project if the performance of the Project Manager is in question.

1.4.3.1 Project Manager Qualifications

The Project Manager must have a minimum 10 years experience as a Project Manager or Superintendent on projects of similar size and complexity.

1.4.4 Non-Compliance Actions

The Project Superintendent is subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to insure timely completion. Furthermore, the Contracting Officer may issue an order stopping in accordance with the Suspension of Work Clause all or part of the work until satisfactory corrective action has been taken. No part of the time

lost due to a suspension of work is acceptable as the subject of claim for extension of time for excess costs or damages by the Contractor.

1.5 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule of prices or earned value report, shop drawings, and other submittals including scheduling programming, prosecution of the work, and clear expectations of the "Interim DD Form 1354" Submittal. Major subcontractors who will engage in the work must also attend.

1.6 FACILITY TURNOVER PLANNING MEETINGS (Red Zone - RZ)

Meet with the Government to identify strategies to ensure the project is carried to expeditious closure and turnover to the Client. Start the turnover process at the Pre-Construction Conference meeting with a discussion of the Red Zone (RZ) process and convene at regularly scheduled RZ Meetings. Include the following in the facility Turnover effort:

1.6.1 RZ Checklist

a. Contracting Officer's Representative (COR) will provide the Contractor a RZ Checklist template at the Preconstruction Conference.

b. Prior to 75 percent or 90 calendar days completion, add/delete critical activities to the RZ Checklist template as necessary to match the project scope, and schedule critical activities and insert planned completion dates in the RZ checklist for each critical activity. Present the RZ Checklist to COR and review during a regularly scheduled QC Meeting.

1.6.2 Meetings

a. Upon Government acceptance of the RZ Checklist, the Project Superintendent is required to lead regular RZ Meetings beginning at approximately 75 percent project completion, or three months prior to the contractual completion date, whichever comes first.

b. The Contracting Officer will determine the frequency of the meetings, which is expected to increase as the project completion draws nearer.

c. Using the RZ Checklist as a Plan of Action and Milestones (POAM) and basis for discussion, review upcoming critical activities and strategies to ensure work is completed on time.

d. Coordinate with the COR any upcoming activities that require Government involvement.

e. Maintain the RZ Checklist by documenting the actual completion dates as work is completed and update the RZ Checklist with revised planned completion dates as necessary to match progress. Distribute copies of the current RZ Checklist to attendees at each RZ Meeting.

1.7 EXPORT LICENSES FOR OVERSEAS PROJECTS

Obtain individual export licenses and project export licenses required by

the Department of Commerce regulations (15 CFR 772 and 15 CFR 773) so that delays are minimized or avoided in shipping from the United States of America to a foreign country. For additional information, the Contractor may contact one of the U.S. and Foreign Commercial Service District Offices of the Department of Commerce which are located in almost every State.

1.8 PARTNERING

To most effectively accomplish this contract, the Government requires the formation of a cohesive partnership within the Project Team whose members are from the Government, the Contractor and their Subcontractors. Key personnel from the Supported Command, the End User (who will occupy the facility), the Government Design and Construction team and Subject Matter Experts, the Installation, the Contractor and Subcontractors, and the Designer of Record will be invited to participate in the Partnering process. The Partnership will draw on the strength of each organization in an effort to achieve a project that is without any safety mishaps, conforms to the Contract, and stays within budget and on schedule.

The Contracting Officer will provide Information on the Partnering Process and a list of key and optional personnel who should attend the Partnering meeting.

1.8.1 Informal Partnering

The Contracting Officer will organize the Partnering Sessions with key personnel of the project team, including Contractor personnel and Government personnel.

The Initial Partnering session should be a part of the Pre-Construction Meeting. Partnering sessions will be held at a location agreed to by the Contracting Officer and the Contractor. The Initial Informal Partnering Session will be conducted and facilitated using electronic media (a video and accompanying forms) provided by the Contracting Officer. The Partners will determine the frequency of the follow-on sessions, at no more than 3 to six month intervals.

1.9 ELECTRONIC MAIL (E-MAIL) ADDRESS

Establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments as text files, pdf files, and other similar formats. Within 10 days after contract award, provide the Contracting Officer a single (only one) e-mail address for electronic communications from the Contracting Officer related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The Contracting Officer may also use email to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes or terrorist threats. Multiple email addresses are not allowed.

It is the Contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office(s). Promptly notify the Contracting Officer, in writing, of any changes to this email address.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 32 17.12 10

COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS)
MED 2/2017

PART 1 GENERAL

1.1 DESCRIPTION

The Contractor is responsible for scheduling procurement, Contractor quality control and construction, acceptance testing and training. Refer to Specification Section 01 33 00 SUBMITTAL PROCEDURES to determine if any items require Government approval prior to construction; if any are required, include that submittal review time in the schedule. The schedule is a tool to manage the project, both for Contractor and Government activities. It will also be used to report progress and evaluate time extensions. The Project NAS must be cost-loaded and will provide the basis for progress payments. Use the Critical Path Method (CPM) and the Precedence Diagram Method (PDM) to satisfy time and cost applications. For consistency, when scheduling software terminology is used in this specification, the terms in Primavera's scheduling programs are used.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications; G M/R

Baseline Network Analysis Schedule (NAS); G M/R

SD-07 Certificates

Monthly Network Analysis Schedule Update; G M

SD-11 Closeout Submittals

As-Built Schedule; G M/R

1.3 SCHEDULE ACCEPTANCE PRIOR TO START OF WORK

Participate with the Contracting Officer in a preliminary meeting(s) to discuss the proposed schedule and requirements of this section prior to the Contractor preparing the Project Baseline Schedule. Government review comments on the Contractor's schedule(s) do not relieve the Contractor from compliance with requirements of the Contract Documents. The acceptance of a Baseline NAS is a condition precedent to:

a. The Contractor starting work on the demolition or construction stage(s) of the contract.

b. Processing Contractor's invoices(s) for construction

activities/items of work.

c. Review of any schedule updates.

Submittal of the Baseline Network Analysis Schedule (NAS), and subsequent schedule updates, is understood to be the Contractor's certification that the submitted schedule meets all of the requirements of the Contract Documents, represents the Contractor's plan on how the work must be accomplished, and accurately reflects the work that has been accomplished and how it was sequenced (as-built logic).

1.4 SOFTWARE

Prepare and maintain project schedules using Primavera P6. Importing data into P6 using data conversion techniques or third party software is cause for rejection of the submitted schedule.

A listing of Primavera P6 settings and parameters which must be used in preparing the Schedules are contained later in this specification section. Deviation from these settings and parameters, without prior consent of the Contracting Officer, is cause for rejection of schedule submission.

1.5 QUALIFICATIONS

The designated Scheduler for the project must have prepared and maintained at least 3 previous schedules of similar size and complexity of this contract using Primavera P3, Primavera SureTrak, or Primavera P6.At least two of the three must be in Primavera P6. Submit a resume outlining the qualifications of the Scheduler. A resume outlining the qualifications of the Scheduler and their Primavera P6 training certificate from an authorized Primavera trainer shall be submitted for acceptance to the Contracting Officer. If at a later date, the Contracting Officer considers the Contractor's Scheduler to be incompetent or objectionable, the Contractor will propose a new Scheduler, meeting the qualification requirements. Payment will not be processed until an acceptable Scheduler is provided.

1.6 NETWORK SYSTEM FORMAT

The system must include time-scaled logic diagrams and specified reports.

1.6.1 Diagrams

Provide Time-scaled Logic Diagram printed in color on Tabloid (11 x 17) (279.4 mm x 431.8 m) size sheets. The diagram must clearly show activities on the critical path. Include the following information for each activity:

a. Activity ID (No more than 10 characters)

b. Activity Description (No more than 30 characters)

c. Original Duration in Work Days

d. Actual Duration in Work Days

e. Remaining duration in Work Days

f. Physical Percent Complete

g. Start Date

h. Finish Date

i. Total Float

1.6.2 Schedule Activity Properties and Level of Detail

The NAS must identify all Government, Construction Quality Management (CQM), and Construction activities planned for the project and all other activities that could impact project completion if delayed. Create separate activities for each Phase, Area, Floor Level and Location the activity is occurring. Follow "USACE Mandatory Requirements" and "ER 1-1-11" documents for creating activity codes and names.

With the exception of the Contract Award and Contract Completion Date (CCD) milestone activities, no activity shall be open-ended; each activity must have predecessor and successor ties. No activity shall have open start or open finish (dangling) logic. Minimize redundant logic ties. Once an activity exists on the schedule it must not be deleted or renamed to change the scope of the activity and must not be removed from the schedule logic without approval from the Contracting Officer. While an activity cannot be deleted, where said activity is no longer applicable to the schedule but must remain within the logic stream for historical record, it can be changed to a milestone. Document any such change in the monthly update, including a date and explanation for the change. The ID number for a deleted activity must not be re-used for another activity. Within the Baseline Schedule no more than 20 percent of the activities may be critical. The most critical path is defined as the longest path with minimum Float. "Near Critical" is defined as having Total Float of 1 to 14 days. Contractor activities must be driven by calendars that reflect local regular holidays and non-work days.

1.6.2.1 Activity Categories

1.6.2.1.1 Procurement Activities

Tasks related to the procurement of material or equipment shall be included as separate activities in the project schedule. Examples of procurement activities include, but are not limited to; Material/equipment submittal preparation, submittal and approval of material/equipment; material/equipment fabrication and delivery, and material/equipment on-site. As a minimum, separate procurement activities will be provided for critical items, long lead items, items requiring Government approval and material/equipment procurement for which payment will be requested in advance of installation. Show each delivery with relationship tie to the Construction Activity specifically for the delivery.

1.6.2.1.2 Government Activities

Government and other agency activities that could impact progress must be clearly identified. Government activities include, but are not limited to; Government approved submittal reviews, Government conducted inspections/tests, environmental permit approvals by utility outages Notice(s) to Proceed (NTP), and delivery of Government Furnished Material/Equipment.

1.6.2.1.3 Quality Management (QM) Activities

The Preparatory Phase and Initial Phase for each Definable Feature of Work identified in the Contractor's Quality Control Plan must be added to each Three-Week Look Ahead Schedule referenced in the paragraph THREE-WEEK LOOK AHEAD SCHEDULE. The Follow-up Phase will be represented by the Construction Activities in the Baseline Schedule and in the schedule updates.

1.6.2.1.4 Construction Activities

No on-site construction activity must have a duration in excess of 20 working days. Contractor activities must be driven by calendars that reflect local holidays and non-work days, unless otherwise defined in this contract.

1.6.2.1.5 Lags

Lags will not be used when the creation of an activity will perform the same function (e.g., concrete cure time). Lag durations contained in the project schedule shall not have a negative value. Use of lags will be kept to the minimum level and Contractor will identify any lag proposed and provide justification with compelling reason for each lag in the Narrative Report.

1.6.2.1.6 Critical Activities

The following activities, when applicable, shall be listed as separate line activities on the Contractor's project schedule:

a. Submission and approval of mechanical / electrical layout drawings.
b. Submission and approval of O&M manuals.
c. Submission and approval of as-built drawings.
d. Submission and approval of 1354 data and installed equipment lists.
e. Submission and approval of testing and air balance (TAB).
f. Submission of TAB specialist design review support.
g. Submission and approval of fire protection specialist.
h. Submission and approval of testing and balancing of HVAC plus commissioning plans and data.
i. Air and water balance dates.
j. HVAC commissioning dates.
k. Controls testing plans.
l. Controls testing.
m. Performance Verification testing.
n. Other systems testing, if required
o. Pre-final Inspection
p. Correction of Punch List from Pre-final Inspection
q. Final Inspection

1.6.2.2 Contract Milestones and Constraints

1.6.2.2.1 Project Start Date Milestones

Include as the first activity on the schedule a start milestone titled "Contract Award", which must have a Mandatory Start constraint equal to the Contract Award Date.

1.6.2.2.2 Facility Turnover Planning Meeting Milestones See paragraph ACTIVITY CATEGORIES above.

1.6.2.2.3 Projected Completion Milestone

Include an unconstrained finish milestone on the schedule titled "Projected Completion". Projected Completion is defined as the point in time the Government would consider the project complete. This milestone must have the Contract Completion (CCD) milestone as its only successor.

1.6.2.2.4 Contract Completion Date (CCD) Milestone

Include as the last activity on the schedule a finish milestone titled "Contract Completion (CCD)". The "CCD" activity shall have a mandatory finish constraint equal to the contract completion date for the project. Calculation of schedule updates must be such that if the finish of the "Projected Completion" milestone falls after the contract completion date, then negative float will be calculated on the longest path and if the finish of the "Projected Completion" miles falls before the contract completion date, the float calculation must reflect positive float on the longest path.

1.6.2.3 Work Breakdown Structure & Activity Code

At a minimum, the Contractor must establish a Work Breakdown Structure (WBS) and provide activity codes identified as follows:

1.6.2.3.1 Work Breakdown Structure (WBS)

Group all activities and milestones within appropriate WBS categories including, at a minimum, the following:

a. Project Milestones:

(1) Management Milestones

(2) Project Administrative Meetings

b. Pre-Construction Phase:

(1) Submittals and Reviews

(2) Procurement

c. Construction Phase; Create multiple sub-sections in accordance with project specific categories of work including in WBS descending order as follows:

(1) General Area

(a) Type of Work Item
(b) Location

d. Commissioning & Testing:

(1) Specific area/locations of commissioning

(2) Final Testing

(3) Training

e. Project Closeout: Include activity items such as Punchlist, Demobilization, O&M, As-built Drawings, and As-built NAS.

f. Modifications: Create multiple sub-sections as the project progresses identified by modifications issued.

1.6.2.3.2 Activity Code Dictionary and Values

The Contractor shall use the activity coding structure defined in the Standard Data Exchange Formant (SDEF) in ER-1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used. The codes will have values assigned that will allow the scheduling program to sort, select, group and organize the activities in the schedule.

1.6.2.4 Anticipated Weather Lost Work Days

Use the following schedule of anticipated monthly non-work days due to adverse weather as the basis for establishing a "Weather Calendar" showing the number of anticipated non-workdays for each month due to adverse weather, in addition to all local non-work days, including weekends

MONTHLY ANTICIPATED ADVERSE WEATHER DELAYS											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2	2	3	0	2	2	2	2	0	0	1

Assign the Weather Calendar to any activity that could be impacted by adverse weather. The Contracting Officer will issue a modification in accordance with the contract clauses, giving the Contractor a time extension for the difference of days between the anticipated and actual adverse weather delay if the number of actual adverse weather delay days exceeds the number of days anticipated for the month in which the delay occurs and the adverse weather delayed activities are critical to contract completion. A lost workday due to weather conditions is defined as a day in which the Contractor cannot work at least 50 percent of the day on the impacted activity.

1.6.2.5 Cost Loading

1.6.2.5.1 Cost Loading Activities

Assign Material and Equipment Costs, for which payment will be requested in advance of installation, to their respective procurement activity (i.e., the material/equipment on-site activity). Assign cost for material /equipment, paid for after installation; labor; and construction equipment to their respective Construction Activities. The value of commissioning, testing and closeout WBS section must not be less than 10 percent of the total costs for Procurement and Construction Activities. Evenly disperse overhead and profit to each activity over the duration of the project.

1.6.2.5.2 Quantities and Units of Measure

Each cost loaded activity must have a detailed quantity breakdown and unit of measure. Lump sum costing is not acceptable.

1.6.3 Schedule Software Settings and Restrictions

a. Activity Constraints: Date/time constraint(s), other than those required by the contract, are not allowed unless accepted by the Contracting Officer in writing. Identify any constraints proposed and provide an explanation for the purpose of the constraint in the Narrative Report as described in Paragraph REQUIRED TABULAR REPORTS.

b. Default Progress Data Disallowed: Actual Start and Actual Finish dates on the CPM schedule must match the dates on the Contractor Quality Control and Production Reports.

c. Software Settings: Handle schedule calculations and Out-of-Sequence progress (if applicable) through Retained Logic, not Progress Override. Show all activity durations and float values in days. Show activity progress using Remaining Duration. Set default activity type to "Task Dependent".

d. At a minimum, include the following settings and parameters in Baseline Schedule preparation:

(1) General: Define or establish Calendars and Activity Codes at the "Project" level, not the "Global" level.

(2) Admin Drop-Down Menu, Admin Preferences, Time Periods Tab:

(a) Set time periods for P6 to 8.0 Hours/Day, 40.0 Hours/Week, 172.0 Hours/Month and 2000.0 Hours/Year.

(b) Use assigned calendar to specify the number of work hours for each time period: must be checked.

(3) Admin Drop-Down Menu, Admin Preferences, Earned Value Tab:

(a) Earned Value Calculation: Use "Budgeted values with current dates".

(4) Project Level, Dates Tab:

(a) Set "Must Finish By" date to "Contract Completion Date".

(5) Project Level, Defaults Tab:

(a) Duration Type: Set to "Fixed Duration & Units".

(b) Percent Complete Type: Set to "Physical".

(c) Activity Type: Set to "Task Dependent".

(d) Calendar(s): A minimum of 4 calendars will be used in preparing the schedule:

1. Seven (7) days work week, no weekends or holidays, and no weather (7 Day Calendar).This calendar is used for any activity whose duration is measured in consecutive calendar days. These activities are mainly in the design and procurement phases. Examples are concrete curing, design review, fabricate & deliver.

2. Six (6) days work week, with non-work weekend day, and

local public holidays, no weather (Standard Calendar). This calendar is used for construction activities which are not affected by severe weather conditions. Examples are all interior work and above ground structural work which is not temperature sensitive such as structural steel erection. Some activities may require interior conditioning of the construction spaces prior to start, for example, gypsum installation, painting, etc.

3. Six (6) days work week with non-work weekend, public holidays and severe weather days as listed in Section 1.42.1 Time Extensions for Unusually Severe Weather (Weather Calendar) This calendar is used for construction activities which cannot or will not be performed in severe weather conditions (such precipitation, high or low temperature, wind), such as earthwork, excavation, compaction, concrete work, exterior plastering etc.

The total number of non-work days for any given month will not exceed the total number of weather days for the month.

Time Extensions that include unusually severe weather days will be recorded on a calendar day basis including weekends and holidays.

The work week must start on Saturday.

4. Five (5) days work week-Federal Calendar, Saturday Sunday and US Federal holiday non-working days. Federal calendar shall be assigned to all Government activities.

Alternative calendars may be used with Contracting Officer's approval.

(6) Project Level, Calculations Tab:

(a) Activity percent complete based on activity steps: Must be checked.

(b) Reset Remaining Duration and Units to Original: Must be checked.

(c) Subtract Actual from At Completion: Must be checked.

(d) Recalculate Actual units and Cost when duration percent complete changes: Must be Checked.

(e) Link Actual to Date and Actual This Period Units and Cost: Must be Checked.

(f) Price/Unit: Set to "$1/h".

(g) Update units when costs change on resource assignments: Must be Unchecked.

(7) Project Level, Settings Tab:

(a) Define Critical Activities: Check Longest Path on General tab. check "calculate multiple float paths", select "total float" radio button and specify at least 5 number-of-paths-to-calculate on advanced tab. Also, select "project completion date milestone" for Display-multiple-float-paths row on advance tab.

(8) Work Breakdown Structure Level, Earned Value Tab:

(a) Technique for Computing Performance Percent Complete: "Activity percent complete" is selected.

(b) Technique for Computing Estimate to Complete (ETC): "PF = 1" is selected.

1.6.4 Required Tabular Reports

Include the following reports with the Baseline, Monthly Update and any other required schedule submittals:

a. Log Report: Listing of all changes made between the previous schedule and current updated schedule.

b. Narrative Report: Identify and justify:

(1) Progress made in each area of the project;

(2) Critical Path;

(3) Date/time constraint(s), other than those required by the contract

(4) Changes in the following; added or deleted activities, original durations, remaining durations for activities that have not started, logic, milestones, planned sequence of operations, critical path, and cost loading;

(5) Any decrease in previously reported activity Earned Amount;

(6) Pending items and status thereof, including permits, changes orders, and time extensions;

(7) Status of Contract Completion Date and interim milestones;

(8) Current and anticipated delays (describe cause of delay and corrective actions(s) and mitigation measures to minimize);

(9) Description of current and future schedule problem areas.

(10) Each entry in the narrative report must cite the respective Activity ID and Activity Description, the date and reason for the change, and description of the change.

(11) Forecast of expected progress in each area of the project for upcoming reporting period, or the following 30 calendar days.

c. Earned Value Report: List all activities having a budget amount cost loaded. Compile total earnings on the project from notice to proceed to current progress payment request. Show current budget, previous physical percent complete, to-date physical percent complete, previous earned value, to-date earned value and cost to complete on the report for each activity.

d. Schedule Variance Control (SVC) Diagram: With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates and 2) Earned Value to-date. Revise Cash Flow S-Curves when the contract is modified, or as directed by the Contracting Officer.

e. Daily Reported Production Activity: Submit on a monthly basis, in electronic spreadsheet format, a summary of daily reported production activity for the reporting month in the update schedule. Use the following columns for reporting:

(1) Date

(2) Activity ID

(3) Work Description

(4) Contractor

(5) Billable Hours

f. Total Float Report: List of all activities by total float in ascending order and then in order of early start date.

g. 30-Day Look Ahead: Activities in progress or scheduled to start or finish within the next thirty (30) calendar days of the project Data Date or is continuing through the thirty (30) day period.

h. Labor Staffing Report and Histogram: With each Baseline Network Analysis Schedule submittal and each updated schedule, a planned early and planned late versus actual labor resource report and histogram will be provided. The report and histogram shall be based upon and shall be in agreement with, the number of shifts and crew sizes by craft, in the Baseline Network Analysis Schedule (planned) and the Monthly Network Update (actual). Included in the report will be a tabular listing of each trade that worked on the activities during the construction period.

i. Equipment Usage Report and Histogram: With each Baseline Network Analysis Schedule submittal and each updated schedule, a planned early and planned late versus actual equipment resource report and histogram will be provided. The report and histogram shall be based upon and shall be in agreement with the equipment allocation in the Baseline Network Analysis Schedule (planned) and the Monthly Network Update (actual). Included in the report will be a tabular listing of equipment (by year, make and model) that worked on the activities during the construction period.

1.7 SUBMISSION AND ACCEPTANCE

1.7.1 Preliminary Schedule

Within 15 days after NTP is acknowledged, contractor must submit a preliminary schedule for approval that covers initial work phases for the first 90 calendar days for the project with appropriate level of details.

1.7.2 Preliminary Meeting

Prior to the preparation of the Baseline Network Analysis Schedule for acceptance; the Contracting Officer, Contract Administration Branch (CAB) scheduler, Contractor, contractor scheduler shall participate in a preliminary meeting to discuss the proposed schedule and requirements of baseline schedule prior to submission.

1.7.3 Monthly Network Analysis Updates

Complete baseline schedule must be submitted within 45 calendar days of NTP acknowledgment. Payment for completed work is dependent on an accepted, detailed schedule for that portion of work.
Contractor and Government representatives must meet at monthly intervals to review and agree on the information presented in the updated project schedule. The submission of an acceptable, updated schedule to the Government is a condition precedent to the processing of the Contractor's invoice. Submit an acceptable, updated schedule to the Government regardless of whether a Contractor's invoice is submitted for the given period. The Contractor and Government must agree on percentage of payment for each activity progressed during the update period. Monthly update schedules must incorporate as-built events as they occurred and provide ongoing status of anticipated finish dates. As-built events must correspond to contemporaneous records, including but not limited to, submittals, daily production reports and quality control reports.

Provide the following with each Schedule submittal:

a. Time-Scaled Logic Diagram.

b. Reports listed in paragraph entitled "REQUIRED TABULAR REPORTS."

c. Data disks containing the project schedule. Include the back-up native .xer program files.

1.7.4 As-Built Schedule

As a condition precedent to the release of retention and making final payment, submit an "As-Built Schedule," as the last schedule update showing all activities at 100 percent completion, including any and all punch list items. This schedule must reflect the exact manner in which the project was actually constructed (including actual start and finish dates; and logical sequence of activities) and shall be certified by the Contractor's Project Manager and Construction Scheduler as being a true reflection of the way the project was actually constructed. If more than one person filled the position(s) during the course of the project, each person will provide certification for the period of time they were responsible.

1.8 CONTRACT MODIFICATION

Submit a Time Impact Analysis (TIA) with each cost and time proposal for a proposed change. TIA must illustrate the influence of each change or delay on the Contract Completion Date or milestones. No time extensions will be granted nor delay damages paid unless a delay occurs which consumes all available Project Float, and extends the Projected Finish beyond the Contract Completion Date.

a. Each TIA must be in both narrative and schedule form. The narrative must define the scope and conditions of the change; provide start and finish dates of impact, successor and predecessor activity to impact period, responsible party; describe how it originated, and how it impacts the schedule. The schedule submission must consist of three native files:

(1) Fragnet used to define the scope of the changed condition

(2) Most recent accepted schedule update as of the time of the proposal or claim submission that has been updated to show all activity progress as of the time of the impact start date.

(3) The impacted schedule that has the fragnet inserted in the updated schedule and the schedule "run" so that the new completion date is determined.

b. For claimed as-built project delay, the inserted fragnet TIA method must be modified to account for as-built events that have already occurred or is occurring after the data date of schedule update used.

c. All TIAs must include any mitigation, and must determine the apportionment of the overall delay assignable to each individual delay. The associated narrative must clearly describe the findings in a chronological listing beginning with the earliest delay event.

(1) Identify types of delays as follows:

(a) Excusable Delay: Force-Majeure (e.g. weather) - Contractor may receive time extension, but time will not be compensable.

(b) Inexcusable Delay: Contractor Responsibility - Contractor must not receive time extension.

(c) Compensable Delay: Government Responsibility - Contractor may receive compensable time extension.

(2) If a combination of delay types occurs, it is considered Concurrent Delay, which is defined in the following combinations:

(a) Excusable Delay and Compensable Delay results in Excusable Delay

(b) Excusable Delay and Inexcusable Delay results in Inexcusable Delay

(c) Compensable Delay and Inexcusable Delay results in Excusable Delay

d. Submit Data disks containing the narrative and native schedule files.

e. Unless the Contracting Officer requests otherwise, only add confirmed contract modifications into the Project NAS.

1.8.1 No Reservation of Rights

All direct costs, indirect cost, and time extensions must be negotiated and made full, equitable and final at the time of modification issuance.

1.9 FLOAT

Use of float suppression techniques, such as; preferential sequencing (arranging critical path through activities more susceptible to Government caused delay), lag logic restraints, zero total or free float constraints, extended activity times, or imposing constraint dates other than as required by the contract, shall be cause for rejection of the project schedule or its updates. The use of Resource Leveling (or similar

software features) used for the purpose of artificially adjusting activity durations to consume float and influence the critical path is expressly prohibited.

1.10 THREE-WEEK LOOK AHEAD SCHEDULE

Prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Project Network Analysis Schedule. Key the work plans to NAS activity numbers and update each week to show the planned work for the current and following two-week period.
Additionally, include upcoming outages, closures, field evaluation tests, preparatory meetings, and initial meetings. Identify critical path activities on the Three-Week Look Ahead Schedule. The detail work plans are to be bar chart type schedules, derived from but maintained separately from the Project NAS on an electronic spreadsheet program and printed on 216 by 279 mm sheets as directed by the Contracting Officer. Activities must not exceed 5 working days in duration and have sufficient level of detail to assign crews, tools and equipment required to complete the work. The 3-Week Look Ahead Schedule is reviewed during the weekly CQC Coordination and/or Production Meeting.

1.11 CORRESPONDENCE AND TEST REPORTS

All correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs) must reference Schedule activity IDs that are being addressed. All test reports (e.g., concrete, soil compaction, weld, pressure) must reference schedule activity IDs that are being addressed.

1.12 ADDITIONAL SCHEDULING REQUIREMENTS

Any references to additional scheduling requirements, including systems to be inspected, tested and commissioned, that are located throughout the remainder of the Contract Documents, are subject to all requirement of this section.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

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SECTION 01 33 00

SUBMITTAL PROCEDURES
05/11

PART 1 GENERAL

1.1 SUMMARY

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

A submittal register showing items of equipment and materials for when submittals are required by the specifications is provided as "Exhibit A - Submittal Register".

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to issuance of contract notice to proceed or the start of the next major phase of the construction on a multi-phase contract, includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

List of proposed Subcontractors

List of proposed products

Construction progress schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices or Earned Value Report

Health and safety plan

Work plan

Quality Control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that the product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods, or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and state the test results; and indicate whether the material, product, or

system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.2.2 Approving Authority

Office or designated person authorized to approve submittal.

1.2.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register; G M/R

1.4 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.4.1 Government Approved (G)

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, they are considered to be "shop drawings."

1.4.2 For Information Only

Submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.5 FORWARDING SUBMITTALS

1.5.1 Procedures

a. Submittals designated as "M" (Middle East District) on the Submittal Register (ENG Form 4288) shall be submitted electronically utilizing RMS CM in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM).

b. Submittals designated as "R" (Resident Office) on the Submittal Register (ENG Form 4288) shall be submitted electronically utilizing RMS CM in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM).

c. Submittals designated as "M/R" on the Submittal Register (ENG Form 4288) shall be submitted electronically utilizing RMS CM in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM).

d. "For Information Only" (FIO) submittals shall be submitted electronically utilizing RMS CM in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM).

e. Sample submittals shall only be submitted to the Bahrain Resident Office.

f. Submittals of operation and maintenance manuals in one hard copy and two (2) CDs shall be submitted to the Bahrain Resident Office.

g. Mailing Addresses for Bahrain Resident Office:

U.S. Army Corps of Engineers
Bahrain Resident Office
PSC 851 Box 30
FPO AE 09834
Attn: Resident Engineer

The Government will further discuss detailed submittal procedures with the Contractor at the Preconstruction Conference.

1.6 PREPARATION

1.6.1 Transmittal Form

Use ENG Form 4025-R for submitting both Government approved and

information only submittals in accordance with the instructions on the reverse side of the form. These forms are included in the RMS CM software that the Contractor is required to use for this contract. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.6.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.

e. Section number of the specification section by which submittal is required.

f. Submittal description (SD) number of each component of submittal.

g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

h. Product identification and location in project.

1.6.3 Format for SD-02 Shop Drawings

Shop drawings are not to be less 11 by 17 inches nor more than 22 by 34 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

Present by 11 x 17 inches sized shop drawings as part of the electronic volume for submittals required by section. Present larger drawings in sets.

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph IDENTIFYING SUBMITTALS.

Number drawings in a logical sequence. Each drawing is to bear the number of the submittal in a uniform location adjacent to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Include the nameplate data, size and capacity on drawings. Also include applicable federal, military, industry and technical society publication references.

Submit drawings in PDF format.

1.6.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

Present product data submittals for each section as a electronic volume. Include table of contents, listing page and catalog item numbers for product data.

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of SD-07 Certificates.

Provide product data in metric dimensions. Where product data are included in preprinted catalogs with English units only, submit metric dimensions on separate sheet.

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of construction effort.

Submit manufacturer's instructions prior to installation.

1.6.5 Format of SD-04 Samples

Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 50 by 75 mm: Built up to 210 by 297 mm.

c. Sample of Materials Exceeding 210 by 297 mm: Cut down to 210 by 297 mm and adequate to indicate color, texture, and material variations.

d. Sample of Linear Devices or Materials: 250 mm length or length to be supplied, if less than 250 mm. Examples of linear devices or materials are conduit and handrails.

e. Sample of Non-Solid Materials: 750 ml. Examples of non-solid materials are sand and paint.

f. Color Selection Samples: 50 by 100 mm. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

g. Sample Panel: 1200 by 1200 mm.

h. Sample Installation: 10 square meters.

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at time of use.

Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.

When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.6.6 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates in electronic volumes only.

1.6.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Provide reports in electronic volumes only.

Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.6.8 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA and Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for O&M Data format.

1.6.9 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.

Provide all dimensions in administrative submittals in metric. Where data are included in preprinted material with English units only, submit metric dimensions on separate sheet.

1.6.10 Source Drawings for Shop Drawings

The entire set of Source Drawing files (DWG) will not be provided to the Contractor. Only those requested by the Contractor to prepare shop drawings may be provided. Request the specific Drawing Number only for the preparation of Shop Drawings. These drawings may only be provided after award.

1.6.10.1 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic Source Drawing files are not construction documents. Differences may exist between the Source Drawing files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic Source Drawing files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished Source Drawing files, the signed and sealed construction documents govern. The Contractor is responsible for determining if any conflict exists. Use of these Source Drawing files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic Source Drawing files for use in producing construction data related to this contract, remove all previous indicia of ownership (seals, logos, signatures, initials and dates).

1.6.11 Electronic File Format

Provide submittals in electronic format, with the exception of material samples required for SD-04 Samples items. Compile the submittal file as a single, complete document, to include the Transmittal Form described within. Name the electronic submittal file specifically according to its contents, coordinate the file naming convention with the Contracting Officer. Electronic files must be of sufficient quality that all information is legible. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer. Generate PDF files from original documents with bookmarks so that the text included in the PDF file is both searchable and can be copied. If documents are scanned, Optical Character Resolution (OCR) routines are required. Index and bookmark files exceeding 30 pages to allow efficient navigation of the file. When required, the electronic file must include a valid electronic signature, or scan of a signature.

Hard copies of any submittal may be requested at the discretion of the Contracting Officer, at no additional cost to the Government.

1.7 INFORMATION ONLY SUBMITTALS

Submittals for information only will be returned. Approval of the Contracting Officer is required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.8 SUBMITTAL REGISTER AND DATABASE

Prepare and maintain submittal register, as the work progresses. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an exhibit. This list may not be all inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)). The Government will provide the initial submittal register in electronic format with the following fields completed, to the extent that will be required by the Government during subsequent usage.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not

consider entries in column (e) as limiting project requirements.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.8.1 Use of Submittal Register

Submit submittal register as an electronic database, using submittals management program furnished to Contractor. Submit with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register database submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.8.2 Contractor Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.8.3 Approving Authority Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.8.4 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request.

1.9 VARIATIONS

Variations from contract requirements require Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.9.1 Considering Variations

When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.9.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

Check the column "variation" of ENG Form 4025 for submittals which include proposed deviations requested by the Contractor. Set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.9.3 Warranting that Variations are Compatible

When delivering a variation for approval, Contractor, warrants that item proposed as a variation will work as a system, if incorporated, and will be compatible with other elements of work.

1.9.4 Review Schedule Extension

In addition to the normal submittal 30 days review period, a period of 30 working days will be allowed for consideration by the Government of submittals with variations.

1.10 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals..

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed

by submittal processing. Allow for potential resubmittal of requirements.

b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.

d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.11 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

a. Note date on which submittal was received from QC Manager.

b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph REVIEW NOTATIONS and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date submittals. Copies of the submittal will be retained by the Contracting Officer and copies of the submittal will be returned to the Contractor.

1.11.1 Review Notations

Contracting Officer review will be completed within 30 calendar days after date of submission.

a. Submittals marked with an "A" (Approved as submitted) code are approved and authorize the Contractor to proceed with the work covered.

b. Submittals marked with a "B" (Approved except as noted) code authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked with a "C" (Approved, resubmission required) code indicate partial compliance with the contract requirements. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. Submittals marked with a "D" (Returned by correspondence) may or may not indicate approval or compliance. The details for this code will be provided in via serialized letter from USACE.

e. Submittals marked with either a code "E" (Disapproved), "G" (Other

specify reason), or "X" (Receipt acknowledged, does not comply) indicates disapproval and/or non-compliance with the contract or that the submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until the resubmittal is approved and require resubmittal and approval.

f. Submittals marked with an "F" (Receipt acknowledged) indicate the submittal has been received and authorize the Contractor to proceed with the work covered.

1.12 DISAPPROVED OR REJECTED SUBMITTALS

Make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the FAR clause entitled CHANGES, is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.13 APPROVED/ACCEPTED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be

returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

1.15 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.16 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements is to be similar to the following:

CONTRACTOR
(Firm Name)
_____ Approved
_____ Approved with corrections as noted on submittal data and/or attached sheets(s)
SIGNATURE: _____
TITLE: _____
DATE: _____

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.
W912ER-14-D-0003

TITLE AND LOCATION
P-964 - Bahrain Shore to Ship Utilities

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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		01 14 00	SD-01 Preconstruction Submittals															
			List of Contact Personnel	1.3.1	G	M/R												
			Special Scheduling Requirements	1.2	G	R												
			SD-06 Test Reports															
			Supporting Documentation	1.3.6	G	M												
		01 15 00.12 10	SD-01 Preconstruction Submittals															
			Requests for Digging Permits	1.4.2	G	R												
			Construction Phasing Plan	1.5														
			Proposed Means of Providing	1.6	G	R												
			Project Security															
			Accident Prevention Plan (APP)	1.8.1														
			Requests for Hot Work Permits	1.17.2	G	R												
			SD-07 Certificates															
			Certificates Of Compliance	1.7														
			SD-11 Closeout Submittals															
			Inventory of all excess supplies,	1.14	G	R												
			materials and equipment															
		01 30 00	SD-01 Preconstruction Submittals															
			Progress and Completion	1.3	G	M/R												
			Pictures															
		01 32 17.12 10	SD-01 Preconstruction Submittals															
			Qualifications	1.5	G	M/R												
			Baseline Network Analysis	1.3	G	M/R												
			Schedule (NAS)															
			SD-07 Certificates															
			Monthly Network Analysis	1.7.3	G	M												

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		01 32 17.12 10	SD-11 Closeout Submittals															
			As-Built Schedule	1.7.4	G	M/R												
		01 33 00	SD-01 Preconstruction Submittals															
			Submittal Register	1.8	G	M/R												
		01 35 26	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.7	G	M												
			SD-06 Test Reports															
			Monthly Exposure Reports	1.4														
			Notifications and Reports	1.12														
			Accident Reports	1.12.3	G	M												
			Epidemic/Pandemic Reporting	1.12.2	G	M												
			LHE Inspection Reports	1.12.4														
			SD-07 Certificates															
			Crane Operators/Riggers	1.6.1.4														
			Standard Lift Plan	1.7.2.2	G	M												
			Critical Lift Plan	1.7.2.3	G	M												
			Activity Hazard Analysis (AHA)	1.8														
			Confined Space Entry Permit	1.9.1														
			Hot Work Permit	1.9.1														
			Certificate of Compliance	1.12.5														
		01 45 00.00 10	SD-01 Preconstruction Submittals															
			Contractor Quality Control (CQC) Plan	3.2	G	R												
		01 50 00	SD-01 Preconstruction Submittals															
			Construction site plan	1.3	G	M/R												
			SD-03 Product Data															

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		01 50 00	Backflow preventers	1.5														
			SD-06 Test Reports															
			Backflow Preventer Tests															
			SD-07 Certificates															
			Backflow Tester	1.5.1														
			Backflow Preventers	1.5														
		01 57 19.12 10	SD-01 Preconstruction Submittals															
			Preconstruction Survey	1.5.1														
			Regulatory Notifications	1.5.2	G	R												
			Environmental Protection Plan	1.8	G	R												
			Employee Training Records	1.5.5	G	R												
			SD-06 Test Reports															
			Laboratory Analysis	3.7.1.1.2														
			Inspection Reports	3.2.1.1														
			Solid Waste Management Report	1.7.1	G	R												
			SD-07 Certificates															
			Employee Training Records	1.5.5	G	R												
			HAZWOPER Certificate Of	1.4.1.2	G	R												
			Completion															
			SD-11 Closeout Submittals															
			Stormwater Pollution Prevention	3.2.1.2	G	R												
			Plan Compliance Notebook															
			Waste Determination	3.7.1	G	R												
			Documentation															
			Disposal Documentation for	3.7.3.6	G	R												
			Hazardous and Regulated Waste															

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		01 57 19.12 10	Assembled Employee Training Records	1.5.5	G	R												
			Solid Waste Management Report	1.7.1	G	R												
			Contractor Hazardous Material Inventory Log	3.8.1	G	R												
			Hazardous Waste/Debris Management	3.7.3.1	G	R												
			Regulatory Notifications	1.5.2	G	R												
			Sales Documentation	3.7.2.1	G	R												
			Contractor Certification	3.7.2.1														
			As-Built Topographic Survey	3.2.1.3														
		01 58 00	SD-02 Shop Drawings															
			Sign Legend Orders	1.3.1	G	M/R												
		01 74 19	SD-01 Preconstruction Submittals															
			Waste Management Plan	1.5	G	M/R												
			SD-06 Test Reports															
			Monthly Solid Waste Disposal Reports	1.7														
			SD-11 Closeout Submittals															
			Records	1.6														
		01 78 00	SD-03 Product Data															
			Warranty Management Plan	1.6.1														
			Warranty Tags	1.6.5														
			Final Cleaning	3.6														
			Spare Parts Data	1.4														
			SD-08 Manufacturer's Instructions															

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		01 78 00	Preventative Maintenance	3.7														
			Condition Monitoring (Predictive	3.7														
			Testing)															
			Inspection	3.7														
			Instructions	1.6.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.5		G R												
			Manuals															
			SD-11 Closeout Submittals															
			As-Built Drawings	3.1		G M/R												
			Record Drawings	3.2		G M/R												
			As-Built Record of Equipment	3.4.1		G M/R												
			and Materials															
			Certification of EPA Designated	2.3		G M/R												
			Items															
			Interim DD FORM 1354	3.8		G R												
		01 78 23	SD-10 Operation and Maintenance															
			Data															
			O&M Database	1.3		G R												
			Training Plan	3.1.1		G R												
			Training Outline	3.1.3		G R												
			Training Content	3.1.2		G R												
			SD-11 Closeout Submittals															
			Training Video Recording	3.1.4		G R												
			Validation of Training Completion	3.1.6		G R												

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		01 78 24.00 20	SD-10 Operation and Maintenance															
			Data															
			Training Plan	3.2.1	G	R												
			Training Outline	3.2.3	G	R												
			Training Content	3.2.2	G	R												
			SD-11 Closeout Submittals															
			eOMSI, Progress Submittal	1.3.1	G	R												
			eOMSI, Prefinal Submittal	1.3.2	G	R												
			eOMSI, Final Submittal	1.3.3	G	R												
			Training Video Recording	3.2.4	G	R												
			Validation of Training Completion	3.2.6	G	R												
		01 91 00.15	SD-01 Preconstruction Submittals															
			Commissioning Firm	1.7	G	M/R												
			Lead Commissioning Specialist	1.7.1	G	M/R												
			Technical Commissioning	1.7.2	G	M/R												
			Specialists															
			Commissioning Firm's Contract	1.7	G	M/R												
			SD-06 Test Reports															
			Design Review Report	3.1.3	G	M												
			Interim Construction Phase	3.1.2.1	G	M												
			Commissioning Plan															
			Final Construction Phase	3.1.2.2	G	M												
			Commissioning Plan															
			Pre-Functional Checklists	3.1.5.2	G	M												
			Issues Log	1.8	G	M												
			Commissioning Report	3.2	G	M												

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		01 91 00.15	SD-07 Certificates															
			Certificate of Readiness	1.9														
			SD-10 Operation and Maintenance															
			Data															
			Training Plan	3.1.6	G	R												
			Training Attendance Rosters	3.1.6	G	R												
			Systems Manual	3.1.7	G	R												
			SD-11 Closeout Submittals															
			Final Commissioning Report	3.2	G	M/R												
		02 41 00	SD-01 Preconstruction Submittals															
			Demolition Plan	1.2.2	G	R												
			Deconstruction Plan	1.2.2	G	R												
			Traffic Control Plan	1.7.1	G	R												
			Existing Conditions	1.9	G	R												
			SD-07 Certificates															
			Notification	1.6														
		03 30 00	SD-01 Preconstruction Submittals															
			Concrete Curing Plan	1.6.3.1	G	R												
			Construction Joints Plan	2.2.5	G	R												
			Quality Control Plan	1.6.5	G	R												
			Quality Control Personnel	1.6.6	G	R												
			Certifications															
			Quality Control Organizational	1.6.6	G	R												
			Chart															
			Laboratory Accreditation	1.6.8	G	R												
			Form Removal Schedule	1.6.2.1	G	R												

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		03 30 00	Maturity Method Data	3.3.9	G	R												
			SD-02 Shop Drawings															
			Formwork	1.6.2.1	G	R												
			Reinforcing Steel	1.6.2.2	G	R												
			SD-03 Product Data															
			Joint Sealants	2.4.5														
			Joint Filler	2.4.4														
			Formwork Materials	2.1														
			Recycled Aggregate Materials	2.3.3.2														
			Cementitious Materials	2.3.1														
			Vapor Barrier	2.4.6														
			Concrete Curing Materials	2.4.1														
			Reinforcement	2.6														
			Liquid Chemical Floor Hardeners and Sealers	2.4.3.1														
			Admixtures	2.3.4														
			Mechanical Reinforcing Bar Connectors	2.6.2														
			Waterstops	2.2.2														
			Local/Regional Materials	1.8.1														
			Biodegradable Form Release Agent	2.2.3														
			Nonshrink Grout	2.4.2														
			SD-05 Design Data															
			Concrete Mix Design	1.6.1.2	G	R												
			Formwork Calculations	1.6.1.1	G	R												

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		03 30 00	SD-06 Test Reports															
			Concrete Mix Design	1.6.1.2	G	R												
			Aggregates	1.6.4.1	G	R												
			Compressive Strength Tests	3.13.2.3	G	R												
			Air Content	3.13.2.4	G	R												
			Slump Tests	3.13.2.1	G	R												
			Water	2.3.2	G	R												
			SD-07 Certificates															
			Reinforcing Bars	2.6.1														
			Welder Qualifications	1.9														
			VOC Content for Form Release	1.6.3.2														
			Agents, Curing Compounds, and															
			Concrete Penetrating Sealers															
			Safety Data Sheets	1.6.3.3														
			Forest Stewardship Council	1.8.2														
			(FSC) Certification															
			Field Testing Technician and	1.6.6.2														
			Testing Agency															
			SD-08 Manufacturer's Instructions															
			Liquid Chemical Floor Hardeners	2.4.3.1														
			and Sealers															
			Joint Sealants	2.4.5														
			Curing Compounds	2.4.1														
		03 49 00	SD-02 Shop Drawings															
			Erection Drawings	1.5.4														
			SD-04 Samples															

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		03 49 00	Finished Face	3.3														
			Mock-up	3.3														
			SD-05 Design Data															
			Mix Designs	1.5.8														
			Engineering Calculations	1.5.5														
			SD-06 Test Reports															
			Glass content by 'wash-out" test	1.5.6														
			Flexural yield strength	1.5.6														
			Flexural ultimate strength	1.5.6														
			Flex anchor/gravity anchor	1.5.6														
			strength															
			Slurry unit weight test	1.5.6														
			Slurry slump test	1.5.6														
			Aggregate gradation testing	1.5.6														
			SD-07 Certificates															
			Certification of Materials	1.5.8														
			SD-08 Manufacturer's Instructions															
			Repair and Cleaning	3.3.7														
			SD-10 Operation and Maintenance															
			Data															
			Panels	3.3														
			SD-11 Closeout Submittals															
			Warranty	1.6														
		04 20 00	SD-02 Shop Drawings															
			Detail Drawings	3.4.1.1	G	M												
			SD-03 Product Data															

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		04 20 00	Hot Weather Procedures	1.5.1														
			Cementitious Materials	2.4.1.1														
			SD-04 Samples															
			Mock-Up Panel	1.3.1.1	G	R												
			Concrete Masonry Units (CMU)	2.2.2.2	G	R												
			Admixtures for Masonry Mortar	2.4.1.4	G	R												
			Anchors, Ties, and Bar Positioners	2.6.2	G	R												
			Joint Reinforcement	2.6.3	G	R												
			Insulation	2.6.7	G	R												
			SD-05 Design Data															
			Masonry Compressive Strength	2.1.2	G	M												
			Bracing Calculations	3.2.5	G	M												
			SD-06 Test Reports															
			Field Testing of Grout	3.6.1.1	G	R												
			SD-07 Certificates															
			Concrete Masonry Units (CMU)	2.2.2.2														
			Precast Concrete Units	2.2.3														
			Cementitious Materials	2.4.1.1														
			Admixtures for Masonry Mortar	2.4.1.4														
			Admixtures for Grout	2.4.2.2														
			Anchors, Ties, and Bar Positioners	2.6.2														
			Joint Reinforcement	2.6.3														
			SD-08 Manufacturer's Instructions															
			Admixtures for Masonry Mortar	2.4.1.4														

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		04 20 00	Admixtures for Grout	2.4.2.2														
		05 40 00	SD-02 Shop Drawings															
			Framing Components	1.6.1	G	M												
			SD-03 Product Data															
			Studs, Joists	2.1														
			Recycled Content of Steel	2.1														
			Products															
			SD-05 Design Data															
			Metal Framing Calculations	1.6.2	G	M												
			SD-07 Certificates															
			Cold-Formed Metal Framing	1.4														
			Welds	3.1.1														
		05 50 13	SD-02 Shop Drawings															
			Expansion Joint Covers	2.4	G	M												
			Expansion Joint Covers	2.4	G	M												
			Floor Gratings	2.5	G	M												
			Floor Gratings	2.5	G	M												
			Dumpster and Chiller Enclosure	2.7	G	M												
			Gates															
			Dumpster and Chiller Enclosure	2.7	G	M												
			Gates															
			Bollards/Pipe Guards	2.6	G	M												
			Miscellaneous Steel Framing for	2.8	G	M												
			Plumbing Fixture Supports in															
			Walls, Louvers and Overhead															
			Coiling Doors															

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		05 50 13	Recycled Content	2.1	G	M												
			Certified Mill	2.2														
		06 10 00	SD-06 Test Reports															
			Preservative-treated	1.4.3	G	R												
			SD-07 Certificates															
			Certificates of Grade	1.9.1														
			Preservative Treatment	1.7														
		07 11 13	SD-07 Certificates															
			Materials	1.3														
		07 13 53	SD-03 Product Data															
			Manufacturer's Standard Details	1.3														
			Elastomeric Waterproofing Sheet	2.2														
			Material															
			Protection Board	2.4														
			Primers, Adhesives, and Mastics	1.4														
			Primers, Adhesives, and Mastics	2.2														
			SD-06 Test Reports															
			Elastomeric Waterproofing Sheet	2.2	G	M												
			Material															
			Field Quality Control	3.7	G	M												
			Protective Covering	3.8	G	M												
			SD-07 Certificates															
			Elastomeric Waterproofing Sheet	2.2														
			Material															
			Primers, Adhesives, and Mastics	1.4														
			Primers, Adhesives, and Mastics	2.2														

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		07 13 53	Special Warranties	1.6															
			Certificates Of Compliance	2.1.1															
			Certificates Of Compliance	2.1.2															
			SD-08 Manufacturer’s Instructions																
			Primers, Adhesives, and Mastics	1.4															
			Primers, Adhesives, and Mastics	2.2															
			SD-11 Closeout Submittals																
			Certificates Of Compliance	2.1.1		G M/R													
			Certificates Of Compliance	2.1.2		G M/R													
		07 21 13	SD-03 Product Data																
			Manufacturer's Standard Details	1.3															
			Block or Board Insulation	2.1															
			Vapor Retarder	2.2															
			Pressure Sensitive Tape	2.3															
			Accessories	2.5															
			Recycled Content for Block or Board Insulation	2.1.4															
			SD-07 Certificates																
			Block or Board Insulation	2.1															
			Vapor Retarder	2.2															
			Indoor Air Quality For Block Or Board Insulation	2.1.5															
			SD-08 Manufacturer’s Instructions																
			Block or Board Insulation	2.1															
			Adhesive	2.5.1															
		07 22 00	SD-02 Shop Drawings																

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		07 22 00	Insulation Board Layout	1.3	G	R												
			SD-03 Product Data															
			Insulation	2.1														
			Cover Board	1.4														
			Fasteners	2.3														
			Recycled Content For Insulation	2.1.2														
			SD-06 Test Reports															
			Flame Spread Rating	1.8.1	G	R												
			SD-07 Certificates															
			Installer Qualifications	1.6														
			Certificates Of Compliance For	1.6														
			Felt Materials															
			Indoor Air Quality For Insulation	2.1.3														
			SD-08 Manufacturer’s Instructions															
			Fasteners	2.3														
			Insulation	2.1														
		07 27 10.00 10	SD-06 Test Reports															
			Design Review Report	1.7	G	M												
			Testing and Inspection	3.1.2	G	M												
			SD-07 Certificates															
			Air Barrier Inspector	1.6														
		07 27 19.01	SD-01 Preconstruction Submittals															
			Qualifications of Manufacturer	1.6.1	G	M/R												
			Qualifications of Installer	1.6.2	G	M/R												
			SD-02 Shop Drawings															
			Self-adhering Air Barrier	1.4	G	M												

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		07 27 19.01	SD-03 Product Data															
			Self-adhering Air Barrier	1.4														
			Primers, Adhesives, and Mastics	2.2														
			Safety Data Sheets	1.4.2														
			SD-06 Test Reports															
			Field Peel Adhesion Test	3.5	G	M												
			Flame Propagation of Wall	1.4.4	G	M												
			Assemblies															
			Flame Spread and Smoke	1.4.4	G	M												
			Developed Index Ratings															
			Site Inspections and Testing	3.4.1	G	M												
			SD-07 Certificates															
			Self-adhering Air Barrier	1.4														
			Qualifications of Manufacturer	1.6.1														
			Qualifications of Installer	1.6.2														
			SD-08 Manufacturer's Instructions															
			Self-adhering Air Barrier	1.4														
			Primers, Adhesives, and Mastics	2.2														
		07 27 26	SD-01 Preconstruction Submittals															
			Qualifications of Manufacturer	1.7.1	G	M/R												
			Qualifications of Installer	1.7.2	G	M/R												
			SD-02 Shop Drawings															
			Fluid-Applied Membrane Air	1.4	G	M												
			Barrier															
			SD-03 Product Data															

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		07 27 26	Fluid-Applied Membrane Air	1.4														
			Barrier															
			Transition Membrane	2.3														
			Primers, Adhesives, and Mastics	2.2														
			Reinforcement	2.6														
			Safety Data Sheets	1.4.2														
			SD-04 Samples															
			Mockup	1.4.3	G	R												
			SD-06 Test Reports															
			Capillary Moisture Test	1.6	G	M												
			Field Peel Adhesion Test	1.4.4	G	M												
			Flame Propagation of Wall	1.4.4	G	M												
			Assemblies															
			Flame Spread and Smoke	1.4.4	G	M												
			Developed Index Ratings															
			Site Inspections	3.4.1	G	M												
			SD-07 Certificates															
			Fluid-Applied Membrane Air	1.4														
			Barrier															
			Transition Membrane	2.3														
			Qualifications of Manufacturer	1.7.1														
			Qualifications of Installer	1.7.2														
			SD-08 Manufacturer’s Instructions															
			Fluid-Applied Membrane Air	1.4														
			Barrier															
			Transition Membrane	2.3														

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		07 27 26	Primers, Adhesives, and Mastics	2.2															
		07 54 19	SD-02 Shop Drawings																
			Detail Drawings	1.6	G	M													
			Roof Plan	1.6	G	M													
			SD-03 Product Data																
			PVC Roofing Membrane	3.3.2															
			Bonding Adhesive	2.1.2															
			Flashing	1.5.4															
			Flashing	3.3.2.2															
			Membrane Fasteners and Plates	2.1.5															
			Pre-Manufactured Accessories	2.1.6															
			Water Cutoffs	3.7.1															
			Information Card	2.1.1															
			SD-05 Design Data																
			Wind Uplift Resistance	1.3.2	G	M													
			SD-07 Certificates																
			Qualification of Manufacturer	1.5.1															
			Qualifications of Applicator	1.5.2															
			Qualification of Engineer of Record	1.5.3															
			Wind Uplift Resistance	1.3.2															
			Fire Resistance	1.3.1															
			Minimum Polymer Thickness	2.1.1															
			Minimum Polymer Thickness	2.1.4															
			Sample	1.10															
			SD-08 Manufacturer’s Instructions																

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		07 54 19	Application Method	3.3															
			Membrane Flashing	2.1.4															
			Membrane Flashing	3.4.2															
			Perimeter Attachment	3.3.4															
			Auxiliary Fasteners	2.1.5.2															
			Pre-Manufactured Accessories	2.1.6															
			Cold Weather	1.8															
			SD-11 Closeout Submittals																
			Warranty	1.10	G	M/R													
			Information Card	2.1.1	G	M/R													
			Instructions to Government Personnel	3.10	G	M/R													
		07 55 00	SD-02 Shop Drawings																
			Roof Assembly	1.2.1	G	M													
			SD-07 Certificates																
			Material and Equipment	1.4.1															
			Energy Efficiency	1.4.2															
			Qualifications	1.4.3															
		07 60 00	SD-02 Shop Drawings																
			Exposed Sheet Metal	2.2.1	G	M													
			Gutters	3.1.16	G	M													
			Downspouts	3.1.17	G	M													
			Expansion Joints	3.1.23	G	M													
			Gravel Stops and fascia	2.2.1	G	M													
			Splash Pans	3.1.20	G	M													
			Base Flashing	3.1.11	G	M													

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		07 60 00	Counterflashing	3.1.12	G	M												
			Flashing at Roof Penetrations	3.1.24	G	M												
			and Equipment Supports															
			Reglets	2.2.9	G	M												
			Scuppers	3.1.18	G	M												
			Copings	2.2.13	G	M												
			Drip Edges	3.1.15	G	M												
			Conductor Heads	3.1.19	G	M												
			Eave Flashing	3.1.21	G	M												
			Recycled Content	2.1	G	M												
			SD-04 Samples															
			Finish Samples	1.4.2	G	R												
			SD-08 Manufacturer’s Instructions															
			Instructions for Installation	1.4.3														
			Quality Control Plan	3.5														
			SD-10 Operation and Maintenance															
			Data															
			Cleaning and Maintenance	1.4.3	G	R												
		07 84 00	SD-02 Shop Drawings															
			Firestopping System	2.1	G	M												
			SD-03 Product Data															
			Firestopping Materials	2.2														
			SD-06 Test Reports															
			Inspection	3.3	G	M												
			SD-07 Certificates															
			Inspector Qualifications	1.5.2														

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		07 84 00	Firestopping Materials	2.2														
			Installer Qualifications	1.5.1														
		07 92 00	SD-03 Product Data															
			Sealants	2.1														
			Primers	2.2														
			Bond Breakers	2.3														
			Backstops	2.4														
			SD-07 Certificates															
			Indoor Air Quality For Interior	2.1.1														
			Sealants															
		08 11 13	SD-02 Shop Drawings															
			Doors	2.1	G	M												
			Doors	2.1	G	M												
			Recycled Content for Steel Door	2.1	G	M												
			Product															
			Frames	2.4	G	M												
			Frames	2.4	G	M												
			Recycled Content for Steel Frame	2.4	G	M												
			Product															
			Accessories	2.2	G	M												
			Weatherstripping	2.6	G	M												
			SD-03 Product Data															
			Doors	2.1														
			Frames	2.4														
			Accessories	2.2														
			Weatherstripping	2.6														

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		08 33 23	SD-02 Shop Drawings																
			Overhead Coiling Doors	2.2.1	G	M													
			Counterbalancing Mechanism	2.2.3	G	M													
			Electric Door Operators	2.2.4	G	M													
			Bottom Bars	2.2.1.3	G	M													
			Guides	2.1.1.1	G	M													
			Mounting Brackets	2.2.3.1	G	M													
			Overhead Drum	2.2.1.8	G	M													
			Hood	3.3.2	G	M													
			Installation Drawings	2.1.1.1	G	M													
			SD-03 Product Data																
			Overhead Coiling Doors	2.2.1															
			Hardware	2.2.2															
			Counterbalancing Mechanism	2.2.3															
			Electric Door Operators	2.2.4															
			SD-05 Design Data																
			Overhead Coiling Doors	2.2.1	G	M													
			Hardware	2.2.2	G	M													
			Counterbalancing Mechanism	2.2.3	G	M													
			Electric Door Operators	2.2.4	G	M													
			SD-10 Operation and Maintenance																
			Data																
			Operation and Maintenance	3.3.2	G	R													
			Manuals																
			Materials	3.3.2	G	R													
			Devices	3.3.2	G	R													

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		08 33 23	Procedures	3.3.2	G	R												
			Manufacture's Brochures	3.3.2	G	R												
			Parts Lists	3.3.2	G	R												
			SD-11 Closeout Submittals															
			Warranty	3.3.1	G	M/R												
		08 71 00	SD-02 Shop Drawings															
			Manufacturer's Detail Drawings	1.3	G	M												
			Verification of Existing Conditions	1.3	G	M												
			Hardware Schedule	1.5	G	M												
			Keying System	2.3.8	G	R												
			SD-03 Product Data															
			Hardware Items	2.3														
			SD-08 Manufacturer’s Instructions															
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Hardware Schedule	1.5	G	R												
			SD-11 Closeout Submittals															
			Key Bitting	1.6.1	G	R												
		08 91 00	SD-02 Shop Drawings															
			Wall louvers	1.4	G	M												
			Wall louvers	1.5	G	M												
			SD-03 Product Data															
			Metal Wall Louvers	2.2														
			SD-04 Samples															
			Wall louvers	1.4	G	R												

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		08 91 00	Wall louvers	1.5	G	R													
			Door louvers	1.5	G	R													
		09 22 00	SD-02 Shop Drawings																
			Metal Support Systems	2.1	G	M													
			SD-03 Product Data																
			Metal Support Systems	2.1															
		09 29 00	SD-03 Product Data																
			Water-Resistant Gypsum Backing	2.1.2															
			Board																
			Abuse Resistant Gypsum Board	2.1.3															
			Accessories	2.1.7															
			Gypsum Board	2.1.1															
			VOC Content of Joint Compound	2.1.4															
			SD-07 Certificates																
			Asbestos Free Materials	2.1															
			Indoor Air Quality	1.3.1															
			SD-08 Manufacturer’s Instructions																
			Safety Data Sheets	2.1															
			SD-10 Operation and Maintenance																
			Data																
			Manufacturer Maintenance	2.1	G	R													
			Instructions																
		09 67 23	SD-01 Preconstruction Submittals																
			Manufacturer's Qualifications	2.2.1	G	M/R													
			Applicator's Qualifications	2.2.1	G	M/R													
			SD-03 Product Data																

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		09 67 23	Resinous Flooring System	2.1															
			SD-04 Samples																
			Resinous Flooring System	2.1	G	R													
			Flooring Surface	2.1	G	R													
			SD-07 Certificates																
			Manufacturer's Certification	2.1															
			SD-08 Manufacturer’s Instructions																
			Care and maintenance	2.1															
			Instructions																
			SD-11 Closeout Submittals																
			Warranty Documentation	2.3	G	M/R													
		09 90 00	SD-02 Shop Drawings																
			Piping Identification	3.9	G	M													
			SD-03 Product Data																
			Coating	2.1															
			SD-04 Samples																
			Color	1.11	G	R													
			Textured Wall Coating System	1.5.2	G	R													
			Sample Textured Wall Coating	1.5.3	G	R													
			System Mock-Up																
			SD-07 Certificates																
			Applicator's Qualifications	1.4															
			Qualification Testing	1.5.1.2															
			Indoor Air Quality for Paints and	2.1															
			Primers																

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		09 90 00	Indoor Air Quality for	2.1														
			Consolidated Latex Paints															
			SD-08 Manufacturer's Instructions															
			Mixing	3.6.2														
			Manufacturer's Safety Data	1.8.2														
			Sheets															
			SD-10 Operation and Maintenance															
			Data															
			Coatings	2.1	G R													
		09 96 00	SD-01 Preconstruction Submittals															
			Equipment List	1.3	G M/R													
			SD-03 Product Data															
			Heat-Resistant Coatings	2.1.1														
			Epoxy Coatings	2.2.1														
			Polyurethane Coatings	2.2.2														
			Chlorinated-Rubber Coatings	2.2.3														
			SD-04 Samples															
			Color Chips	1.3	G R													
			SD-07 Certificates															
			Heat-Resistant Coatings	2.1.1														
			Epoxy Coatings	2.2.1														
			Polyurethane Coatings	2.2.2														
			Chlorinated-Rubber Coatings	2.2.3														
			Manufacturer's Printed	3.1.4														
			Instructions															
		09 97 13.27	SD-05 Design Data															

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		09 97 13.27	Containment System	1.4.4.1	G M												
			SD-06 Test Reports														
			Joint Sealant Qualification Test	1.4.5.1	G M												
			Reports														
			Coatings Qualification Test	1.4.5.2	G M												
			Reports														
			Metallic Abrasive Qualification	1.4.5.3	G M												
			Test Reports														
			Coating Sample Test Reports	3.1.3	G M												
			Abrasive Sample Test Reports	3.1.4	G M												
			Inspection Report Forms	3.8.2.2	G M												
			Daily Inspection Reports	3.8.2.3	G M												
			Recycled Metallic Abrasive Field	1.4.5.4	G M												
			Test Reports (Daily and Weekly)														
			SD-07 Certificates														
			Contract Errors, Omissions, and	1.4.1													
			Other Discrepancies														
			Corrective Action Procedures	1.4.2.1													
			Coating Work Plan	1.4.3													
			Qualifications of Certified	1.4.6.1													
			Industrial Hygienist (CIH)														
			Qualifications Of Individuals	1.4.6.5													
			Performing Abrasive Blasting														
			Qualifications of Certified	1.4.6.2													
			Protective Coatings Specialist														
			(PCS)														

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		09 97 13.27	Qualifications of Coating	1.4.6.3														
			Inspection Company															
			Qualifications of QC Specialist	1.4.6.4														
			Coating Inspector															
			Qualifications of Testing	1.4.6.6														
			Laboratory for Coatings															
			Qualifications of Testing	1.4.6.7														
			Laboratory for Abrasive															
			Qualifications of Coating	1.4.6.8														
			Contractors															
			Joint Sealant Materials	1.4.6.9														
			Coating Materials	1.4.6.10														
			Coating System Component	1.4.6.11														
			Compatibility															
			Non-metallic Abrasive	1.4.6.12														
			Metallic Abrasive	1.4.6.13														
			SD-08 Manufacturer's Instructions															
			Joint Sealant Instructions	1.5.1														
			Coating System Instructions	1.5.2														
			SD-11 Closeout Submittals															
			Disposal of Used Abrasive	3.5.6	G	M/R												
			Inspection Logbook	3.8.2.4	G	M/R												
		10 14 00.10	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1	G	M												
			SD-03 Product Data															
			Modular Exterior Signage System	2.1														

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		10 14 00.10	Installation	3.1														
			Exterior Signage	1.2														
			Wind Load Requirements	1.2.1														
			SD-04 Samples															
			Exterior Signage	1.2	G	R												
			SD-10 Operation and Maintenance															
			Data															
			Protection and Cleaning	3.1.2	G	R												
		10 14 00.20	SD-02 Shop Drawings															
			Detail Drawings	1.4.2	G	M												
			SD-03 Product Data															
			Installation	3.1														
			Warranty	1.6														
			SD-04 Samples															
			Interior Signage	1.4.1	G	R												
			SD-10 Operation and Maintenance															
			Data															
			Approved Manufacturer's	3.1	G	R												
			Instructions															
			Protection and Cleaning	3.1.2	G	R												
			Software	1.3														
		10 26 00	SD-02 Shop Drawings															
			Wall Covering/Panels	2.2	G	M												
			SD-03 Product Data															
			Wall Covering/Panels	2.2														
			SD-04 Samples															

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		10 26 00	Finish	2.4	G	R												
			SD-06 Test Reports															
			Wall Covering/Panels	2.2	G	M												
			Indoor air quality for wall	2.2														
			covering/panels															
			Indoor air quality for adhesives	2.5														
		10 28 13	SD-03 Product Data															
			Finishes	2.1.2														
			Accessory Items	2.2														
			Recycled content for stainless	2.1														
			steel toilet accessories															
			SD-04 Samples															
			Finishes	2.1.2	G	R												
			Accessory Items	2.2	G	R												
			SD-07 Certificates															
			Accessory Items	2.2														
		10 44 16	SD-02 Shop Drawings															
			Fire Extinguishers	Part 2	G	M												
			Accessories	1.2.1	G	M												
			Wall Brackets	1.2.1	G	M												
			SD-03 Product Data															
			Fire Extinguishers	Part 2														
			Accessories	1.2.1														
			Wall Brackets	1.2.1														
			Replacement Parts List	3.2.1														
			SD-04 Samples															

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		10 44 16	Wall Brackets	1.2.1	G	R												
			Accessories	1.2.1	G	R												
			SD-07 Certificates															
			Fire Extinguishers	Part 2														
			Manufacturer's Warranty with	1.3														
			Inspection Tag															
		10 56 29.16 25	SD-03 Product Data															
			Installation instructions	3.2														
			Pallet Storage Racks	1.3														
			Recycled Content	2.2.2														
			Safety Accessories	2.3														
			SD-05 Design Data															
			Load Application and Rack	1.4	G	M												
			Configuration Drawings															
			SD-11 Closeout Submittals															
			Recycled Content	2.2.2	G	M/R												
		13 34 19	SD-01 Preconstruction Submittals															
			Manufacturer's Qualifications	1.6.2	G	M/R												
			Lifting Plan	1.2.10	G	M/R												
			SD-02 Shop Drawings															
			Detail Drawings	1.2.1.6	G	M												
			Detail Drawings	1.6.1	G	M												
			SD-03 Product Data															
			Manufacturer's Catalog Data	1.6.1														
			SD-04 Samples															
			Coil Stock	1.6.1	G	R												

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		13 34 19	Coil Stock	2.1.8	G	R												
			Roof Panels	1.2.1.8	G	R												
			Wall Panels	1.2.1.8	G	R												
			Fasteners	2.5.2	G	R												
			Metal Closure Strips	2.8.1	G	R												
			Insulation	1.4.7	G	R												
			SD-05 Design Data															
			Manufacturer's Descriptive and	1.6.1	G	M												
			Technical Literature															
			Manufacturer's Building Design	1.6.1	G	M												
			Analysis															
			SD-06 Test Reports															
			Test Reports	1.6.1	G	M												
			Coatings and Base Metals	1.6.1	G	M												
			Factory Color Finish Performance	1.6.1	G	M												
			Requirements															
			SD-07 Certificates															
			System Components	1.6.1														
			Coil Stock	1.6.1														
			Coil Stock	2.1.8														
			Aluminized Steel Repair Paint	1.6.1														
			Galvanizing Repair Paint	1.6.1														
			Enamel Repair Paint	1.6.1														
			Qualification of Manufacturer	1.6.1														
			Qualification of Erector	1.6.1														
			SD-08 Manufacturer’s Instructions															

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		13 34 19	Shipping, Handling, and Storage	1.7															
			SD-11 Closeout Submittals																
			Manufacturer's Warranty	3.12.1	G	M/R													
			Contractor's Warranty for	3.12.2	G	M/R													
			Installation																
		13 48 00	SD-02 Shop Drawings																
			Bracing	1.2.3	G	M/R													
			Bracing	2.1	G	M/R													
			Bracing	3.1	G	M/R													
			Resilient Vibration Isolation	3.4	G	M													
			Devices																
			Equipment Requirements	2.1	G	M													
			SD-03 Product Data																
			Bracing	1.2.3															
			Bracing	2.1															
			Bracing	3.1															
			Equipment Requirements	2.1															
			Anchor Bolts	3.3															
			Vibration Isolators	2.1.2															
			Snubbers	3.4.2															
			SD-05 Design Data																
			Design Calculations	1.2.3	G	M													
			SD-06 Test Reports																
			Anchor Bolts	3.3	G	M													
			SD-07 Certificates																
			ICC ES AC156 Shake Table Test	3.6															

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		21 13 13.00 20	SD-02 Shop Drawings															
			Shop Drawings	1.5.2	G	M												
			SD-03 Product Data															
			Pipe	2.1.1														
			Fittings	2.1.1														
			Valves	2.1.5														
			Sprinklers	2.1.4														
			Pipe hangers and supports	2.1.6														
			Mechanical couplings	2.1.1														
			Seismic Bracing	2.1.6														
			SD-05 Design Data															
			Hydraulic Calculations	1.3	G	M												
			SD-06 Test Reports															
			request to schedule Preliminary	3.5	G	M												
			Tests															
			Preliminary Test Report	3.5	G	M												
			request to schedule Final	3.6	G	M												
			Acceptance Test															
			Final Acceptance Test Report	3.6	G	M												
			SD-07 Certificates															
			Inspection by Fire Protection	3.1														
			Engineer															
			Fire Protection Engineer	1.5.1														
			Sprinkler System Installer	1.5.2														
			SD-10 Operation and Maintenance															
			Data															

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		21 13 13.00 20	Operating and Maintenance	3.7	G	R													
			Instructions																
			SD-11 Closeout Submittals																
			As-built drawings	3.6	G	M/R													
			On-site training	3.7	G	M/R													
		22 00 00	SD-01 Preconstruction Submittals																
			Disinfection/Commissioning Plan	3.6.2	G	M/R													
			SD-03 Product Data																
			Fixtures	2.4															
			Flush Valve Water Closets	2.4.1															
			Wall Hung Lavatories	2.4.2															
			Energy Star Label for Wheelchair	2.4.4															
			Electric Water Cooler																
			WaterSense Label for Flush	2.4.1															
			Valve Water Closet																
			Backflow Prevention Assemblies	3.6.3															
			Water Heaters	2.9															
			SD-06 Test Reports																
			Tests, Flushing and Disinfection	3.6	G	M													
			Test of Backflow Prevention	3.6.3	G	M													
			Assemblies																
			SD-07 Certificates																
			Materials and Equipment	1.3															
			Materials	2.1															
			Bolts	2.1.2															
			Solder Material	2.1.2															

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		22 00 00	Solder Flux	2.1.2														
			Asbestos Prohibition	2.1.1														
			SD-10 Operation and Maintenance															
			Data															
			Plumbing System	3.6.1	G	R												
		22 05 48.00 20	SD-02 Shop Drawings															
			Rails	2.6	G	M												
			SD-03 Product Data															
			Isolators	2.3														
			Flexible Connectors	2.7														
			Flexible Duct Connectors	2.8														
			Pipe Guides	2.9														
			Vertical Stops	3.1.3														
			Rails	2.6														
			Machinery Foundations and	3.1.10														
			Subbases															
			Machinery Manufacturer's Sound	1.4.3														
			Data															
			SD-05 Design Data															
			Rails	2.6	G	M												
			Machinery	1.4.4	G	M												
			Machinery over 136 Kilograms	1.4.5	G	M												
			SD-06 Test Reports															
			Equipment Vibration Tests	3.2.3.1	G	M												
			Equipment Sound Level Tests	3.2.3.2	G	M												
			Protected Spring Isolators	2.4	G	M												

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		22 05 48.00 20	SD-08 Manufacturer's Instructions															
			Vibration and Noise Isolation	3.1.1														
			Components															
			Seismic Protection Components	2.10														
		23 00 00	SD-02 Shop Drawings															
			Detail Drawings	1.4.4	G	M												
			SD-03 Product Data															
			Duct Connector	2.9.1.1														
			Duct Access Doors	2.9.2														
			Manual Balancing Dampers	2.9.3														
			Acoustical Duct Liner	2.9.4														
			Registers	2.9.5.1														
			Ceiling Exhaust Fans	2.10.1.1														
			Energy Star label for ceiling	2.10.1.1														
			exhaust fan product															
			Air Handling Units	2.11														
			Room Fan-Coil Units	2.12.1														
			Test Procedures	1.4.5														
			Diagrams	1.2.1.2														
			Indoor Air Quality for Duct	2.9.1														
			Sealants															
			SD-06 Test Reports															
			Performance Tests	3.10	G	M												
			SD-07 Certificates															
			Bolts	1.4.1														

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		23 00 00	Ozone Depleting Substances	1.4.3															
			Technician Certification																
			SD-08 Manufacturer's Instructions																
			Manufacturer's Installation	3.2															
			Instructions																
			Operation and Maintenance	3.12.2															
			Training																
			SD-10 Operation and Maintenance																
			Data																
			Operation and Maintenance	3.12.1	G	R													
			Manuals																
			Manual Balancing Dampers	2.9.3	G	R													
			Ceiling Exhaust Fans	2.10.1.1	G	R													
			Air Handling Units	2.11	G	R													
			SD-11 Closeout Submittals																
			Indoor Air Quality During	3.11	G	M/R													
			Construction																
		23 05 48.19	SD-02 Shop Drawings																
			Coupling and Bracing	3.1	G	M													
			Flexible Couplings or Joints	3.2	G	M													
			Equipment Restraint	2.2	G	M													
			Contractor Designed Bracing	1.2.4	G	M													
			SD-03 Product Data																
			Coupling and Bracing	3.1															
			Flexible Couplings Or Joints	3.2															
			Equipment Restraint	2.2															

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		23 05 48.19	Contractor Designed Bracing	1.2.4														
			Snubbers	2.6														
			Anchor Bolts	3.8														
			Vibration Isolators	2.2.2														
			SD-05 Design Data															
			Design Calculations	1.2.4	G	M												
			SD-06 Test Reports															
			Anchor Bolts	3.8	G	M												
		23 05 93	SD-01 Preconstruction Submittals															
			Records of Existing Conditions	1.3.3	G													
			Independent TAB Agency and	1.5.1	G	M/R												
			Personnel Qualifications															
			TAB Design Review Report	1.5.3.1	G	M/R												
			SD-02 Shop Drawings															
			TAB Schematic Drawings and	1.3.3	G	M												
			Report Forms															
			SD-03 Product Data															
			Equipment and Performance	1.3														
			Data															
			TAB Related HVAC Submittals	1.5.1.3														
			SD-06 Test Reports															
			Prerequisite HVAC Work	1.5.3.2	G	M												
			Checkout List															
			Prerequisite HVAC Work	1.5.3.2	G	M												
			Checkout List															
			Proportional Balancing	3.2.5.1	G	M												

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		23 05 93	Proportional Balancing	3.5	G	M												
			Certified TAB Report	1.5.2.3	G	M												
			SD-07 Certificates															
			Independent TAB Agency and	1.5.1														
			Personnel Qualifications															
			TAB Submittal and Work	1.5.3.1														
			Schedule															
			TAB Pre-Field Engineering	1.5.3.2														
			Report															
			Instrument Calibration	1.5.5														
			Certificates															
			TAB Procedures Summary	3.5														
			Proportional Balancing	3.2.5.1														
			Proportional Balancing	3.5														
			Advance Notice of TAB Field	3.5														
			Work															
		23 07 00	SD-02 Shop Drawings															
			MICA Plates	3.2.2.4	G	M												
			Pipe Insulation Systems	2.3	G	M												
			Pipe Insulation Systems	3.2	G	M												
			Duct Insulation Systems	3.3	G	M												
			Equipment Insulation Systems	3.4	G	M												
			SD-03 Product Data															
			Pipe Insulation Systems	2.3														
			Pipe Insulation Systems	3.2														
			Duct Insulation Systems	3.3														

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		23 07 00	Equipment Insulation Systems	3.4														
			SD-07 Certificates															
			Indoor air quality for adhesives	2.2.1														
			SD-08 Manufacturer's Instructions															
			Pipe Insulation Systems	2.3														
			Pipe Insulation Systems	3.2														
			Duct Insulation Systems	3.3														
			Equipment Insulation Systems	3.4														
		23 09 00	SD-02 Shop Drawings															
			DDC Contractor Design Drawings	3.3	G	M												
			Draft As-Built Drawings	3.3	G	M												
			Final As-Built Drawings	3.3	G	M												
			SD-03 Product Data															
			Programming Software	1.8.1														
			Controller Application Programs	1.8.2														
			Configuration Software	1.5														
			Manufacturer's Product Data	2.2														
			XIF files	2.2.1														
			Draft LNS Database	3.5.3														
			Final LNS Database	3.6.4														
			LNS Plug-ins	1.8.3														
			SD-06 Test Reports															
			Existing Conditions Report	3.1.1	G	M												
			Start-Up Testing Report	3.5.2	G	M												
			PVT Procedures	3.6.1	G	M												
			PVT Report	3.6.3	G	M												

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		23 09 00	Pre-Construction Quality Control	1.9.1	G	M												
			(QC) Checklist															
			Post-Construction Quality Control	1.9.2	G	M												
			(QC) Checklist															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.7	G	R												
			(O&M) Instructions															
			Training Documentation	3.9.1	G	R												
			SD-11 Closeout Submittals															
			Enclosure Keys	2.5	G	M/R												
			Closeout Quality Control (QC)	1.9.3	G	M/R												
			Checklist															
		23 35 19.00 20	SD-02 Shop Drawings															
			Industrial Ventilation and Exhaust	1.2.3	G	M												
			Systems															
			SD-03 Product Data															
			Fans	2.1														
			Flexible Connectors	2.4.3														
			Gaskets	2.4.4														
			Sealants	2.4.5														
			Access Ports	2.5.1														
			Ductwork, Dust and Fume	2.7														
			Collection															
			Vibration Isolators	2.6.5														

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		23 35 19.00 20	Recycled Content of Ductwork	2.7.1														
			Steel Components															
			Indoor Air Quality for Duct	2.4.5.1														
			Sealants															
			SD-06 Test Reports															
			Fan Tests	2.1.1	G	M												
			Start-Up Tests	1.2.4	G	M												
			SD-10 Operation and Maintenance															
			Data															
			Fans	2.1	G	R												
			SD-11 Closeout Submittals															
			Posted Operating Instructions	1.5	G	M/R												
		23 64 10	SD-03 Product Data															
			Self-Contained Water Chillers	2.4														
			Verification of Dimensions	1.6.1														
			System Performance Tests	3.5														
			Demonstrations	3.6														
			Refrigerant	2.5.1														
			Water Chiller - Field Acceptance	3.4.1														
			Test Plan															
			SD-06 Test Reports															
			Field Acceptance Testing	3.4	G	M												
			Water Chiller - Field Acceptance	3.4.2	G	M												
			Test Report															
			System Performance Tests	3.5	G	M												
			SD-07 Certificates															

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		23 64 10	Ozone Depleting Substances	1.3.1														
			Technician Certification															
			SD-08 Manufacturer's Instructions															
			Water Chiller - Installation	3.1														
			Instructions															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.6	G R													
			Manuals															
			SD-11 Closeout Submittals															
			Indoor Air Quality During	3.3	G M/R													
			Construction															
		23 64 26	SD-02 Shop Drawings															
			Record Drawings	1.2	G M													
			SD-03 Product Data															
			Calibrated Balancing Valves	2.3.4														
			Water Pressure Reducing Valve	2.3.5														
			Pressure Relief Valve	2.3.6														
			Plate and Frame Heat Exchanger	2.9														
			Chilled Water Buffer Tank	2.10														
			Pumps	2.5														
			Expansion Tanks	2.6														
			Air Separator Tanks	2.7														
			Water Treatment Systems	2.8														
			SD-06 Test Reports															
			Pressure Tests Reports	3.4.2	G M													

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		23 64 26	Valve-Operating Tests	3.1	G	M													
			SD-07 Certificates																
			Employer's Record Documents	3.1.1.1															
			(For Welding)																
			Welding Procedures and	3.1.1.2															
			Qualifications																
			SD-08 Manufacturer's Instructions																
			Lesson plan for the Instruction	3.5															
			Course																
			SD-10 Operation and Maintenance																
			Data																
			Calibrated Balancing Valves	2.3.4	G	R													
			Water Pressure Reducing Valve	2.3.5	G	R													
			Pressure Relief Valve	2.3.6	G	R													
			Pumps	2.5	G	R													
			Expansion Tanks	2.6	G	R													
			Air Separator Tanks	2.7	G	R													
		23 81 00	SD-03 Product Data																
			Coil Corrosion Protection	2.5.1															
			System Performance Tests	3.5															
			Inventory	1.4															
			Environmental Data	2.2.2.4															
			Manufacturer's Standard Catalog	2.2															
			Data																
			Supplied Products	2.1															
			SD-06 Test Reports																

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		23 81 00	Refrigerant Tests, Charging, and	3.4	G	M												
			Start-Up															
			System Performance Tests	3.5	G	M												
			SD-07 Certificates															
			Service Organizations	3.6.1														
			SD-11 Closeout Submittals															
			Ozone Depleting Substances	2.2.2.2	G	M/R												
		25 05 11.21	SD-01 Preconstruction Submittals															
			Device Account Lock Exception	3.1.2.2	G	M/R												
			Request															
			Multiple IP Connection Device	3.8	G	M/R												
			Request															
			Contractor Computer	1.10.1.4	G	M/R												
			Cybersecurity Compliance															
			Statements															
			Contractor Temporary Network	1.10.5	G	M/R												
			Cybersecurity Compliance															
			Statements															
			SD-02 Shop Drawings															
			User Interface Banner Schedule	3.1.3.1	G	M												
			Network Communication Report	1.8.1	G	M												
			Cybersecurity Riser Diagram	1.8.4	G	M												
			Control System Inventory Report	1.8.2	G	M												
			SD-03 Product Data															
			Control System Cybersecurity	1.8.5														
			Documentation															

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		25 05 11.21	SD-07 Certificates															
			Software Licenses	1.9														
			Cybersecurity Representative's	1.7.1														
			Certification of Qualifications															
			SD-11 Closeout Submittals															
			Password Summary Report	3.5.2.2.4	G	M/R												
			Device Audit Record Upload	3.2.2.1	G	M/R												
			Software															
		25 05 11.23	SD-01 Preconstruction Submittals															
			Device Account Lock Exception	3.1.2.2	G	M/R												
			Request															
			Multiple IP Connection Device	3.9	G	M/R												
			Request															
			Contractor Computer	1.10.1.4	G	M/R												
			Cybersecurity Compliance															
			Statements															
			Contractor Temporary Network	1.10.5	G	M/R												
			Cybersecurity Compliance															
			Statements															
			SD-02 Shop Drawings															
			User Interface Banner Schedule	3.1.3.1	G	M												
			Network Communication Report	1.8.1	G	M												
			Cybersecurity Riser Diagram	1.8.4	G	M												
			Control System Inventory Report	1.8.2	G	M												
			SD-03 Product Data															

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		25 05 11.23	Control System Cybersecurity Documentation	1.8.5	G	M												
			SD-07 Certificates															
			Cybersecurity Representative's Certification of Qualifications	1.7.1	G	M												
			Software Licenses	1.9	G	M												
			SD-11 Closeout Submittals															
			Password Summary Report	3.5.2.2.4	G	M/R												
			Software Recovery And Reconstitution Images	1.8.3	G	M/R												
			Device Audit Record Upload Software	3.2.2.1	G	M/R												
		25 05 11.26	SD-01 Preconstruction Submittals															
			Device Account Lock Exception Request	3.1.2.2	G	M/R												
			Multiple IP Connection Device Request	3.9	G	M/R												
			Contractor Computer Cybersecurity Compliance Statements	1.10.1.4	G	M/R												
			Contractor Temporary Network Cybersecurity Compliance Statements	1.10.5	G	M/R												
			SD-02 Shop Drawings															
			User Interface Banner Schedule	3.1.3.1	G	M												
			Network Communication Report	1.8.1	G	M												

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		25 05 11.26	Cybersecurity Riser Diagram	1.8.4	G	M													
			Control System Inventory Report	1.8.2	G	M													
			SD-03 Product Data																
			Control System Cybersecurity	1.8.5	G	M													
			Documentation																
			SD-07 Certificates																
			Software Licenses	1.9	G	M													
			Cybersecurity Representative's	1.7.1	G	M													
			Certification of Qualifications																
			SD-11 Closeout Submittals																
			Password Summary Report	3.5.2.2.4	G	M/R													
			Device Audit Record Upload	3.2.2.1	G	M/R													
			Software																
			Software Recovery And	1.8.3	G	M/R													
			Reconstitution Images																
		25 08 10	SD-06 Test Reports																
			Building Level DDC Testing	3.1	G	M													
			Sequence																
			Field Test Requirements	3.4	G	M													
			Performance Verification Test	3.5	G	M													
		26 05 33	SD-02 Shop Drawings																
			600 V Power Connection Station	2.1	G	M													
			600 V Power Connection Station	2.1	G	M													
			600 V Transformer Secondary	2.1	G	M													
			Tap Box																
			SD-03 Product Data																

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		26 05 33	600 V Single Pole Connectors	2.1.2															
			Industrial Power Station Auxiliary	2.1.3															
			Devices																
			Metering Accessories	2.1.4															
			SD-06 Test Reports																
			Paint Coating System	2.5.1	G	M													
			600 V Single Pole Connector	2.5.2	G	M													
			Compatibility Tests																
			600 V Single Pole Connector	2.5.3	G	M													
			Torque Test																
			Acceptance Checks and Tests	3.6.1	G	M													
			SD-10 Operation and Maintenance																
			Data																
			600 V Power Connection Station	2.1	G	R													
		26 05 48.00 10	SD-02 Shop Drawings																
			Lighting Fixtures in Buildings	3.2	G	M													
			Equipment Requirements	1.3	G	M													
			SD-03 Product Data																
			Lighting Fixtures in Buildings	3.2															
			Equipment Requirements	1.3															
			Contractor Designed Bracing	1.2.4															
		26 08 00	SD-06 Test Reports																
			Acceptance tests and inspections	3.1	G	M													
			SD-07 Certificates																
			Qualifications	1.4.1															

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		26 08 00	Acceptance test and inspections	1.4.3															
			procedure																
		26 11 16	SD-02 Shop Drawings																
			Unit Substation Drawings	1.5.1.1	G	M													
			Unit Substation Specification and	1.5.1.2	G	M													
			Drawing Review																
			Transformer drawings	1.5.1.3	G	M													
			SD-03 Product Data																
			Secondary unit substation	2.2															
			transformer (liquid-filled)	2.2.2															
			SD-05 Design Data																
			Capacity Calculations for Battery	1.5.8	G	M													
			Charger and Batteries																
			SD-06 Test Reports																
			Acceptance checks and tests	3.6.1	G	M													
			SD-07 Certificates																
			Paint coating system	1.5.2															
			Transformer Losses	1.5.3															
			SD-09 Manufacturer's Field																
			Reports																
			transformer design tests	2.6.2															
			(liquid-filled)																
			transformer routine and other	2.6.3															
			tests (liquid-filled)																
			SD-10 Operation and Maintenance																
			Data																

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		26 11 16	Unit substations	2.2	G	R													
			SD-11 Closeout Submittals																
			Assembled Operation and	1.6.1	G	M/R													
			Maintenance Manuals																
			Equipment test schedule	2.6.1	G	M/R													
		26 12 19.10	SD-02 Shop Drawings																
			Pad-mounted Transformer	1.5.1	G	M													
			Drawings																
			SD-03 Product Data																
			Pad-mounted Transformers	2.2															
			SD-06 Test Reports																
			Acceptance Checks and Tests	3.6.1	G	M													
			SD-07 Certificates																
			Transformer Efficiencies	2.2.2.1															
			SD-09 Manufacturer's Field																
			Reports																
			Transformer Test Schedule	2.7.1															
			Design Tests	2.7.2															
			Routine and Other Tests	2.7.3															
			SD-10 Operation and Maintenance																
			Data																
			Transformer(s)	1.6.1	G	R													
		26 12 23	SD-02 Shop Drawings																
			SFC Transformer Drawings	1.4.1	G	M													
			SD-03 Product Data																
			SFC Transformers	2.2															

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		26 12 23	SD-05 Design Data																
			Structural Design Report	3.4.1	G	M													
			SD-06 Test Reports																
			Acceptance Checks and Tests	3.5.1	G	M													
			SD-07 Certificates																
			Transformer Efficiencies	2.2.2.2															
			Paint Coating System	1.4.2															
			SD-09 Manufacturer's Field																
			Reports																
			Transformer Design Tests	2.3.2															
			Routine and Other Tests	2.3.3															
			SD-10 Operation and Maintenance																
			Data																
			SFC Transformer O&M	1.5.2	G	R													
			SD-11 Closeout Submittals																
			Assembled Operation and	1.5.1	G	M/R													
			Maintenance Manuals																
			Equipment Test Schedule	2.3.1	G	M/R													
		26 13 00	SD-02 Shop Drawings																
			Switchgear Drawings	1.5.1	G	M													
			SD-03 Product Data																
			Electronic Overcurrent Control	1.5.3															
			Curves																
			SF6/High-Firepoint Fluid	1.6.1															
			Insulated Pad-mounted Switchgear																

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		26 13 00	SF6/High-Firepoint Fluid	2.1														
			Insulated Pad-mounted Switchgear															
			Insulated High-Voltage	2.2														
			Connectors															
			Surge Arresters	2.3														
			SD-06 Test Reports															
			Acceptance Checks and Tests	3.4.1	G	M												
			SD-07 Certificates															
			Paint Coating System	1.5.2														
			Cybersecurity	1.7														
			SD-09 Manufacturer's Field															
			Reports															
			Switchgear design and production	2.4.1														
			tests															
			SD-10 Operation and Maintenance															
			Data															
			SF6/High-Firepoint Fluid	1.6.1	G	R												
			Insulated Pad-mounted Switchgear															
			SF6/High-Firepoint Fluid	2.1	G	R												
			Insulated Pad-mounted Switchgear															
		26 20 00	SD-02 Shop Drawings															
			Panelboards	2.12	G	M												
			Transformers	2.14	G	M												
			Cable trays	2.4	G	M												
			Wireways	2.24	G	M												
			Marking strips	3.1.11.1	G	M												

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		26 20 00	SD-03 Product Data															
			Receptacles	2.11														
			Circuit breakers	2.12.3														
			Switches	2.9														
			Transformers	2.14														
			Enclosed circuit breakers	2.13														
			Motor controllers	2.16														
			Grounding Busbar	2.19.3														
			Surge protective devices	2.25														
			SD-06 Test Reports															
			1000-volt wiring test	3.5.2	G	M												
			Grounding system test	3.5.5	G	M												
			Transformer tests	3.5.3	G	M												
			Ground-fault receptacle test	3.5.4	G	M												
			SD-07 Certificates															
			Fuses	2.10														
			SD-09 Manufacturer’s Field															
			Reports															
			Transformer factory tests	2.27.1														
			SD-10 Operation and Maintenance															
			Data															
			Electrical Systems	1.5.1	G	R												
		26 23 00	SD-02 Shop Drawings															
			Switchgear Drawings	1.5.2	G	M												
			SD-03 Product Data															
			Switchgear	2.2														

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		26 23 00	SD-06 Test Reports																
			Switchgear Design Tests	2.5.2	G	M													
			Switchgear Production Tests	2.5.3	G	M													
			Acceptance Checks and Tests	3.5.1	G	M													
			SD-07 Certificates																
			Cybersecurity Equipment Certification	2.5.4															
			Cybersecurity Installation Certification	3.5.1.6															
			SD-10 Operation and Maintenance Data																
			Switchgear Operation and Maintenance	1.6.1	G	R													
			SD-11 Closeout Submittals																
			Assembled Operation and Maintenance Manuals	1.6.2	G	M/R													
			Equipment Test Schedule	2.5.1	G	M/R													
			Service Entrance Available Fault Current Label	2.7	G	M/R													
		26 27 14.00 20	SD-02 Shop Drawings																
			Installation Drawings	1.4.1	G	M													
			SD-03 Product Data																
			Electricity meters	2.1.4															
			Current transformer	2.1.3															
			Potential transformer	2.1.2															
			communications	2.2															

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		26 27 14.00 20	Configuration Software	3.1.1														
			SD-06 Test Reports															
			Acceptance checks and tests	3.2.1	G	M												
			System functional verification	3.2.2	G	M												
			Building meter installation sheet, per building	3.2.1	G	M												
			Completed meter installation schedule	3.2.1	G	M												
			Completed meter data schedule	3.2.1	G	M												
			Meter configuration template	2.1.1	G	M												
			Meter configuration report	3.2.1	G	M												
			SD-10 Operation and Maintenance Data															
			Electricity Meters and Accessories	1.5.1	G	R												
			SD-11 Closeout Submittals															
			System functional verification	3.2.2	G	M/R												
		26 28 01.00 10	SD-03 Product Data															
			Fault Current Analysis	2.12														
			Protective Device Coordination Study	2.12														
			Equipment	2.1														
			System Coordinator	1.4.1														
			Protective Relays	3.3.5														
			Installation	3.2														
			SD-06 Test Reports															

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		26 28 01.00 10	Field Testing	3.3	G	M													
			SD-07 Certificates																
			Devices and Equipment	1.6															
			SD-11 Closeout Submittals																
			Single Line Diagram	2.12.3	G	M/R													
		26 29 23	SD-02 Shop Drawings																
			Schematic Diagrams	1.5.1	G	M													
			Interconnecting Diagrams	1.5.2	G	M													
			Installation Drawings	1.5.3	G	M													
			SD-03 Product Data																
			Variable Frequency Drives	2.1															
			Wires and Cables	2.3															
			Equipment Schedule	1.5.4															
			SD-06 Test Reports																
			VFD Test	3.2.1	G	M													
			Performance Verification Tests	3.2.2	G	M													
			Endurance Test	3.2.3	G	M													
			SD-08 Manufacturer's Instructions																
			Installation instructions	1.5.5															
			SD-09 Manufacturer's Field																
			Reports																
			VFD Factory Test Plan	2.5.1															
			Factory test results	1.5.6															
			SD-10 Operation and Maintenance																
			Data																
			Variable Frequency Drives	2.1	G	R													

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # PARAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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		26 32 13.00 20	SD-02 Shop Drawings															
			Engine-Generator Set and	1.5.1.1	G	M												
			Auxiliary Equipment															
			UL 142 Fuel Tank Drawings with	1.5.4	G	M												
			UL 142 Label															
			SD-03 Product Data															
			Engine-Generator Set Data	1.3.1														
			Engine-Generator Set	1.3.2														
			Efficiencies															
			Diesel Engine Data	1.3.3														
			Generator and Exciter Data	1.3.4														
			Diesel Engine-Generator Set	2.1														
			Auxiliary Systems and Equipment	2.2														
			SD-05 Design Data															
			Capacity Calculations for	1.3.5	G	M												
			Engine-Generator Set															
			Torsional Vibration Stress	1.3.6	G	M												
			Analysis Computations															
			Capacity Calculations For	1.3.7	G	M												
			Batteries															
			SD-06 Test Reports															
			Acceptance Checks and Tests	3.5.1	G	M												
			Functional Acceptance Tests	3.5.2	G	M												
			Functional Acceptance Test	3.4.4	G	M												
			Procedure															
			Tank Integrity Test	3.5.1.6	G	M												

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		26 32 13.00 20	SD-07 Certificates															
			Vibration Isolation System	1.5.2														
			Fuel System	1.5.3														
			Start-Up Engineer	3.3														
			Instructor's	3.6.1														
			SD-09 Manufacturer’s Field															
			Reports															
			Engine Tests	2.6.1														
			Generator Tests	2.6.2														
			Assembled Engine-Generator Set	2.6.3														
			Tests															
			SD-10 Operation and Maintenance															
			Data															
			Diesel Engine-Generator Set	2.1	G R													
			Auxiliary Systems and Equipment	2.2	G R													
			Preliminary Assembled Operation	3.4.3	G R													
			and Maintenance Manuals															
			SD-11 Closeout Submittals															
			Posted Operating Instructions	1.8.2	G M/R													
			Training Plan	3.6.2	G M/R													
		26 35 43	SD-02 Shop Drawings															
			SFC Drawings	1.4.1	G M													
			Short Circuit Model	1.4.1.1	G M													
			SD-03 Product Data															
			Static Frequency Converter	2.1														
			SD-05 Design Data															

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		26 35 43	Structural Design Report	1.4.4	G	M													
			SD-06 Test Reports																
			Work Plan	1.4.2.4	G	M													
			Routine Factory Test Plan	1.4.2.1	G	M													
			Special Factory Test Plan	1.4.2.2	G	M													
			Performance Test Plan	1.4.2.3	G	M													
			Equipment Test Schedule	2.4.1	G	M													
			Routine Factory Test Reports	1.4.2.5	G	M													
			Special Factory Test Reports	1.4.2.6	G	M													
			Acceptance Checks and Tests	3.2.2	G	M													
			SD-07 Certificates																
			Qualifications of Manufacturer	1.4.3															
			Start-Up Engineer	1.4.2															
			SD-09 Manufacturer's Field																
			Reports																
			Performance Test Reports	1.4.2.7															
			Training Syllabus	3.3.1															
			SFC Design Tests	2.4.3															
			Routine Factory Tests	2.4.2															
			SD-10 Operation and Maintenance																
			Data																
			SFC Assembly O & M	1.5.1	G	R													
			Local O & M Manuals	1.5.1.1	G	R													
			Preliminary O & M Manuals	1.5.1.2	G	R													
		26 35 53	SD-02 Shop Drawings																
			SFC House Drawings	1.4.1	G	M													

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		26 35 53	SD-03 Product Data																
			SFC House	2.1															
			SD-05 Design Data																
			SFC Structural Design Report	3.4	G	M													
			SD-06 Test Reports																
			Equipment Test Schedule	2.2.1	G	M													
			Acceptance Checks and Tests	3.5.1	G	M													
			SD-07 Certificates																
			Paint Coating System	1.4.2															
			SD-10 Operation and Maintenance																
			Data																
			SFC House O & M	1.5.1	G	R													
			SD-11 Closeout Submittals																
			Local O & M Manuals	1.5.2	G	M/R													
		26 36 23.00 20	SD-02 Shop Drawings																
			Automatic Transfer Switch	1.4.2	G	M													
			Drawings																
			SD-03 Product Data																
			Automatic Transfer Switches	2.1															
			SD-06 Test Reports																
			Acceptance Checks and Tests	3.3.1	G	M													
			Functional Acceptance Tests	3.3.2	G	M													
			SD-07 Certificates																
			Proof of Listing	1.4.1															
			SD-10 Operation and Maintenance																
			Data																

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		26 36 23.00 20	Automatic Transfer Switches	2.1	G	R												
		26 51 00	SD-02 Shop Drawings															
			Luminaire Drawings	1.5.1	G	M												
			Occupancy/Vacancy Sensor Coverage Layout	1.5.2	G	M												
			SD-03 Product Data															
			Luminaires	2.2														
			Light Sources	2.4														
			Drivers	2.3														
			LED Luminaire Warranty	1.6.1														
			Luminaire Design Data	1.5.4														
			Vacancy Sensors	2.5.2.2														
			Exit Signs	2.6.1														
			Emergency Lighting Unit (EBU)	2.6.2														
			LED Emergency Drivers	2.6.3														
			Occupancy Sensors	2.5.2.1														
			Bi-Level HID Controller	2.5.3														
			SD-06 Test Reports															
			LED Luminaire - IES LM-79 Test Report	1.5.5	G	M												
			LED Light Source - IES LM-80 Test Report	1.5.6	G	M												
			LED Light Source - IES TM-21 Test Report	1.5.7	G	M												
			Energy Efficiency	1.5.10.3	G	M												
			SD-07 Certificates															

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		26 51 00	Luminaire Useful Life Certificate	1.6.1.1														
			LED Driver and Dimming Switch	1.5.3														
			Compatibility Certificate															
		27 10 00	SD-02 Shop Drawings															
			Telecommunications drawings	1.6.1.1	G M													
			Telecommunications Space	1.6.1.2	G M													
			Drawings															
			SD-03 Product Data															
			Telecommunications cabling	2.3														
			Patch panels	2.4.5														
			Telecommunications	2.5														
			outlet/connector assemblies															
			Equipment support frame	2.4.2														
			Connector blocks	2.4.3														
			SD-06 Test Reports															
			Telecommunications cable	3.5.1	G M													
			testing															
			SD-07 Certificates															
			Telecommunications Contractor	1.6.2.1														
			Key Personnel	1.6.2.2														
			Manufacturer Qualifications	1.6.2.3														
			Test plan	1.6.3														
			SD-09 Manufacturer's Field															
			Reports															
			Factory reel tests	2.11.1														

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		27 10 00	SD-10 Operation and Maintenance																
			Data																
			Telecommunications cabling and	1.10.1	G	R													
			pathway system																
			SD-11 Closeout Submittals																
			Record Documentation	1.10.2	G	M/R													
		28 08 10	SD-05 Design Data																
			Test Plan	3.1	G	M													
			SD-06 Test Reports																
			Draft Test Report	3.2.2	G	M													
			Final Test Report	3.4	G	M													
			SD-07 Certificates																
			Qualifications	1.4.1															
		28 10 05	SD-02 Shop Drawings																
			ESS Components	1.3.3.1	G	M													
			Overall System Schematic	1.3.3.2	G	M													
			SD-03 Product Data																
			Access Control Devices	2.2.1															
			SD-07 Certificates																
			Contractor Qualifications	1.3.4.1															
			SD-11 Closeout Submittals																
			As-Built Drawings	1.4	G	M/R													
		28 31 63.00 20	SD-02 Shop Drawings																
			Point-to-Point Wiring Diagrams	1.5.1	G	M/R													
			Plan View Drawing	1.5.1	G	M/R													
			Battery power calculations	1.5.2	G	M/R													

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		28 31 63.00 20	Riser Diagrams	1.5.1	G	M/R													
			SD-03 Product Data																
			Fire alarm control panel (FACP)	2.1.10															
			Manual stations	2.1.11															
			Transmitters	2.1.13															
			Batteries	2.1.8.1															
			Battery chargers	2.1.8.3															
			Smoke sensors	2.1.5															
			Thermal sensors	2.1.6															
			Wiring	2.1.9.3															
			Wiring	2.3															
			Notification appliances	2.1.12															
			Addressable interface devices	2.1.4															
			Digital alarm communicator	2.1.13.1															
			transmitter (DACT)																
			SD-06 Test Reports																
			Preliminary Test Results	3.4.1	G	M													
			SD-07 Certificates																
			Qualifications of installer	1.5.3															
			SD-10 Operation and Maintenance																
			Data																
			Interior Fire Alarm System	2.1	G	R													
			Record drawing software	1.5.4	G	R													
			SD-11 Closeout Submittals																
			As-Built Drawings	1.5.3	G	M/R													
			Installer's Training History	1.5.3	G	M/R													

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		31 00 00	SD-01 Preconstruction Submittals															
			Shoring	3.4	G	M/R												
			Dewatering Work Plan	1.4.3	G	M/R												
			SD-03 Product Data															
			Utilization of Excavated Materials	3.8														
			Opening of any Excavation or	3.3														
			Borrow Pit															
			SD-06 Test Reports															
			Testing	3.15	G	R												
			Borrow Site Testing	2.1	G	R												
			SD-07 Certificates															
			Testing	3.15														
		31 23 19.01	SD-06 Test Reports															
			Water Control Plan	1.4	G	R												
			Discharge permit	3.6	G	R												
			Settlement Benchmark Elevations	3.7	G	R												
			Inflow Measurements	3.5	G	R												
		31 42 00	SD-01 Preconstruction Submittals															
			Qualifications	1.7	G	M/R												
			Certificate of Design	1.7	G	M/R												
			Certification Letter	1.7	G	M/R												
			Trenching/Shoring AHA	1.7	G	M/R												
			SD-02 Shop Drawings															
			Drawings and Computations	1.7	G	M												
		31 50 00	SD-02 Shop Drawings															

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		31 50 00	Steel Casing Pipe for Tunneled	2.1	G	M												
			Crossing															
			SD-05 Design Data															
			Design calculations	1.4	G	M												
		31 60 00	SD-01 Preconstruction Submittals															
			Safety Plan	3.4	G	M/R												
			Emergency Response Plan	3.4	G	M/R												
			Carrier Pipe Supports	3.1	G	M												
			Bulkheads	3.1	G	M												
			Grout Pipes	3.1	G	M												
			Vent Pipes	3.1	G	M												
			Drain Lines	3.1	G	M												
			SD-08 Manufacturer's Instructions															
			Installation Instructions	3.1														
			Carrier Pipe installation	1.4	G	M/R												
			instructions															
		31 63 29	SD-02 Shop Drawings															
			Drilled Shaft Diameters	2.1.1	G	M												
			Depth of Test Holes	2.1.1	G	M												
			Top and Bottom of Shaft	2.1.1	G	M												
			Elevations															
			Steel Reinforcement	2.1.1	G	M												
			Anchor Bolt Locations	2.1.1	G	M												
			Accessories	2.1.1	G	M												
			SD-05 Design Data															

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		31 63 29	Drilled Shaft Foundation Design	2.1	G	M												
			Analysis															
			Mix Design Data	2.1	G	M												
			SD-06 Test Reports															
			Soils Report	3.3.3	G	M												
			Ground Water Conditions	3.3.3	G	M												
			Load Test	3.3.3	G	M												
			Penetration Test	3.3.3	G	M												
			Slump	3.3.3	G	M												
			Concrete	3.3.3	G	M												
			Compressive Strength	3.3.3	G	M												
			SD-07 Certificates															
			Bill of Lading for Ready-Mix	2.1														
			Concrete Deliveries															
			Steel Reinforcement	2.1.1														
			Welding Certificates	1.4.6														
			Excavation and Drilling	2.2.1														
			Equipment															
			Qualifications of Excavator	1.4.4														
			Qualifications of Engineer	1.4.5														
		31 74 28	SD-01 Preconstruction Submittals															
			Qualifications	2.4.1	G	M/R												
			Work Plans	3.1	G	M/R												
			Mix Design	2.2	G	M/R												
			Personnel Qualifications	2.4.1	G	M/R												
			SD-03 Product Data															

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		31 74 28	Product Data	2.3	G	M/R												
			Manufacturer's specifications and	2.3	G	M/R												
			operation instructions for															
			conveyance equipment															
			Material Specifications	3.2.1	G	M/R												
			SD-07 Certificates															
			Certificate of Compliance	3.2.1	G	M/R												
			Placement Reports and	3.2.1	G	M/R												
			Certifications															
			SD-09 Manufacturer’s Field															
			Reports															
			Daily Reports	3.3														
			Backfill Grouting Records	3.3														
		31 79 13	SD-01 Preconstruction Submittals															
			Qualifications	1.7	G	M/R												
			Quality Control Methods	1.6	G	M/R												
			Microtunneling Equipment	1.5	G	M/R												
			Pre- and Post-Construction	1.6	G	M/R												
			Surveys															
			Results of line and grade survey	1.6	G	M/R												
			Safety Plan	1.8	G	M/R												
			SD-05 Design Data															
			Calculations	1.5	G	M												
			Contingency Plans	1.7	G	M/R												
			Schedule	3.1	G	M/R												

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		31 79 13	SD-09 Manufacturer's Field															
			Reports															
			Daily Records	3.1														
		31 80 00	SD-01 Preconstruction Submittals															
			Qualifications	1.4	G	M/R												
			Instrumentation Schedule	3.1	G	M/R												
			Monitoring Plan	3.1	G	M/R												
			SD-05 Design Data															
			Drawings	3.1	G	M/R												
			SD-06 Test Reports															
			Preconstruction Survey	3.1	G	M												
		32 11 23	SD-03 Product Data															
			Plant, Equipment, and Tools	1.4														
			SD-06 Test Reports															
			Initial Tests	2.3.1	G	R												
			In-Place Tests	3.12.1	G	R												
		32 12 16	SD-03 Product Data															
			Mix Design	2.4														
			Quality Control	3.10														
			Material Acceptance	3.11														
			SD-04 Samples															
			Asphalt Cement Binder	2.3	G	R												
			Aggregates	2.2	G	R												
			SD-06 Test Reports															
			Aggregates	2.2	G	R												
			QC Monitoring	3.10.3.10	G	R												

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		32 12 16	SD-07 Certificates																
			Asphalt Cement Binder	2.3															
			Testing Laboratory	3.6															
		32 13 13.06	SD-03 Product Data																
			Curing Materials	2.1.6															
			Admixtures	2.1.4															
			Dowel	2.1.5.1															
			Reinforcement	2.1.5.4															
			Cementitious Materials	2.1.1															
			Aggregate	2.1.3															
			SD-04 Samples																
			Field-Constructed Mockup	1.6.5	G	R													
			SD-05 Design Data																
			Mix Design	2.3	G	R													
			SD-06 Test Reports																
			Aggregate	2.1.3	G	R													
			Concrete Slump Tests	3.7.2	G	R													
			Air Content Tests	3.7.4	G	R													
			Flexural Strength Tests	3.7.3	G	R													
			Cementitious Materials	2.1.1	G	R													
			SD-07 Certificates																
			Ready-mixed Concrete Plant	1.6.1															
			Batch Tickets	1.6.4															
			Cementitious Materials	2.1.1															
		32 13 73	SD-03 Product Data																
			Equipment	2.1															

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		32 13 73	Manufacturer's Instructions	3.1.1															
			SD-04 Samples																
			Compression Seals	2.2	G	R													
			SD-06 Test Reports																
			Test Requirements	2.1.3	G	R													
		32 16 15	SD-04 Samples																
			Concrete Paving Block	2.1.2	G	R													
			SD-06 Test Reports																
			Tests, Inspections and Verifications	2.2	G	R													
		32 16 19	SD-03 Product Data																
			Concrete	2.1															
			Biodegradable Form Release Agent	2.6.5															
			Biodegradable Form Release Agent	3.2															
			SD-06 Test Reports																
			Field Quality Control	3.8	G	R													
		32 17 23	SD-03 Product Data																
			Surface Preparation Equipment List	2.1.1.1															
			Application Equipment List	2.1.2															
			Exterior Surface Preparation	3.2															
			Safety Data Sheets	1.3.1															
			Waterborne Paint	2.2.1															
			Solventborne Paint	2.2.2															

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		32 17 23	SD-06 Test Reports																
			Waterborne Paint	2.2.1	G	R													
			Solventborne Paint	2.2.2	G	R													
			SD-07 Certificates																
			Qualifications	1.3.2															
			Waterborne Paint	2.2.1															
			Solventborne Paint	2.2.2															
			Volatile Organic Compound	1.3.1															
			SD-08 Manufacturer's Instructions																
			Waterborne Paint	2.2.1															
			Solventborne Paint	2.2.2															
		32 31 13.53	SD-02 Shop Drawings																
			Fence Installation	1.3.2	G	R													
			Fence Installation	3.1	G	R													
			Installation Drawings	1.3.2	G	R													
			Location of gate, corner, end, and pull posts	1.3.2	G	R													
			Gate Assembly	1.3.2	G	R													
			Gate Assembly	2.6.1	G	R													
			Gate Assembly	2.6.1	G	R													
			Gate Hardware and Accessories	1.3.2	G	R													
			Gate Hardware and Accessories	2.6.3	G	R													
			SD-03 Product Data																
			Fence Installation	1.3.2															
			Fence Installation	3.1															
			Gate Assembly	1.3.2															

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		32 31 13.53	Gate Assembly	2.6.1														
			Gate Assembly	2.6.1														
			Gate Hardware and Accessories	1.3.2														
			Gate Hardware and Accessories	2.6.3														
			SD-04 Samples															
			Fabric	2.1.1		G R												
			Posts	2.2		G R												
			Post Caps	2.2.2		G R												
			Braces	2.3		G R												
			Sleeves	3.1.3		G R												
			Barbed Wire	2.4.2		G R												
			Barbed Wire Supporting Arms	2.2.2		G R												
			Stretcher Bars	2.1.1		G R												
			Gate Posts	2.1.1		G R												
			Gate Hardware and Accessories	1.3.2		G R												
			Gate Hardware and Accessories	2.6.3		G R												
			Wire Ties	2.4.1		G R												
			Tension Wire	2.2.2		G R												
			SD-06 Test Reports															
			zinc coating	1.3.1		G R												
			SD-07 Certificates															
			Chain Link Fence	2.2.1														
			Reports	1.3.1														
			Reports	1.3.1														
			Zinc Coating	1.3.1														
			Fabric	2.1.1														

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		32 31 13.53	Barbed Wire	2.4.2														
			Stretcher Bars	2.1.1														
			Gate Hardware and Accessories	1.3.2														
			Gate Hardware and Accessories	2.6.3														
			Concrete	2.5														
			SD-08 Manufacturer's Instructions															
			Fence Installation	1.3.2														
			Fence Installation	3.1														
			Gate Assembly	1.3.2														
			Gate Assembly	2.6.1														
			Gate Assembly	2.6.1														
			Accessories	1.3.1														
		33 11 00	SD-01 Preconstruction Submittals															
			Connections	3.1.1	G	M/R												
			SD-03 Product Data															
			Pipe, Fittings, Joints and Couplings	2.1.1														
			Valves	2.1.2														
			Valve Boxes	2.1.2.4														
			Fire Hydrants	2.1.4.1														
			Pipe Restraint	2.2.1														
			Disinfection Procedures	3.2.2	G	R												
			SD-06 Test Reports															
			Bacteriological Samples	3.3.1.3	G	R												
			Hydrostatic Sewer Test	3.2.1.1.5	G	R												
			Leakage Test	3.3.1.2	G	R												

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		33 11 00	Hydrostatic Test	3.3.1.1	G	R												
			SD-07 Certificates															
			Pipe, Fittings, Joints and	2.1.1														
			Couplings															
			Lining	2.1.1.1.1														
			Valves	2.1.2														
			Fire Hydrants	2.1.4.1														
			SD-08 Manufacturer's Instructions															
			Ductile Iron Piping	2.1.1.1														
			HDPE Pipe for Service Lines	2.1.1.2														
		33 30 00	SD-01 Preconstruction Submittals															
			Contractor's License	1.3.1	G	M/R												
			SD-02 Shop Drawings															
			Installation Drawings	3.1.1	G	R												
			SD-03 Product Data															
			Precast Concrete Manholes	2.2.6														
			Frames, Covers, and Gratings	2.2.11														
			Gravity Pipe	2.2.1														
			Pressure Pipe	2.2.2														
			Precast Concrete Oily Waste	2.2.9														
			Tanks															
			SD-06 Test Reports															
			Precast Concrete Sewer Manhole	3.3.1.2.1	G	R												
			Test															
			Hydrostatic Sewer Test	3.3.1.1	G	R												
			Negative Air Pressure Test	3.3.1.2.1	G	R												

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		33 30 00	Low-Pressure Air Tests	3.3.1.2.2	G	R												
			Tests For Pressure Lines	3.3.1.3	G	R												
			SD-07 Certificates															
			Portland Cement	2.2.4														
			Pre-Installation Inspection	3.3.3.1														
			Request															
			Post-Installation Inspection	3.3.3.2														
		33 32 16	SD-03 Product Data															
			Submersible Sewage Non-Clog	2.2														
			Pumps															
			Pump Performance Curve	2.3														
			Pump Motor	2.3														
			Pump Control System	2.4														
			Wet Well and Valve Vault	2.5														
			Flexible Flanged Coupling	2.6.4														
			Station Piping	2.6														
			Valves	2.7														
			SD-05 Design Data															
			Buoyancy Calculations	2.5.1.1	G	M												
			SD-10 Operation and Maintenance															
			Data															
			Submersible Sewage Non-Clog	2.2	G	R												
			Pumps															
			Warranty	1.6	G	R												
		33 32 17	SD-02 Shop Drawings															
			Equipment Installation	3.2	G	M												

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		33 32 17	SD-03 Product Data															
			Materials and Equipment	2.2														
			Framed Instructions	3.4														
			SD-06 Test Reports															
			Field Testing and Adjusting	3.5	G	M												
			Equipment															
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.7	G	R												
			Manuals															
		33 71 02	SD-02 Shop Drawings															
			Precast underground structures	1.5.1	G	M												
			SD-03 Product Data															
			Medium voltage cable	2.5														
			Medium voltage cable joints	2.7														
			Medium voltage cable	2.6														
			terminations															
			Precast concrete structures	2.13.2.1														
			Sealing Material	2.13.2.4														
			Pulling-In Irons	3.4.3														
			Manhole frames and covers	2.13.3														
			Handhole frames and covers	2.13.4														
			Composite/fiberglass handholes	2.13.6														
			Cable supports	2.14														
			SD-06 Test Reports															

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		33 71 02	Medium voltage cable	2.18.2	G	M												
			qualification and production tests															
			Field Acceptance Checks and	3.18.1	G	M												
			Tests															
			Arc-proofing test	2.18.1	G	M												
			Cable Installation Plan and	3.3	G	M												
			Procedure															
			SD-07 Certificates															
			Cable splicer/terminator	1.5.2														
			Cable Installer Qualifications	1.5.3														
			Certificate of Conformance	1.5.4														
		33 82 00	SD-02 Shop Drawings															
			Telecommunications Outside	1.6.1.1	G	M												
			Plant															
			SD-03 Product Data															
			Wire and cable	2.8														
			Cable splices, and connectors	2.5														
			Closures	2.3														
			Protected Entrance Terminals	2.2.1														
			Protector modules	2.2.1														
			Cross-connect terminal cabinets	2.4														
			SD-06 Test Reports															
			Pre-installation tests	3.4.1	G	M												
			Acceptance tests	3.4.2	G	M												
			Outside Plant Test Plan	1.6.3	G	M												
			SD-07 Certificates															

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		33 82 00	Telecommunications Contractor	1.6.2.1														
			Key Personnel	1.6.2.2														
			Manufacturer's Qualifications	1.6.2.3														
			SD-08 Manufacturer’s Instructions															
			Protected Entrance Terminals	2.2.1														
			Cable tensions	3.1.6.1														
			Fiber Optic Splices	3.1.7.2														
			SD-09 Manufacturer’s Field															
			Reports															
			Factory Reel Test Data	2.15.1														
			SD-10 Operation and Maintenance															
			Data															
			Telecommunications outside	1.6.1.1	G	R												
			plant (OSP)															
			SD-11 Closeout Submittals															
			Record Documentation	1.8.1	G	M/R												
		35 45 01	SD-02 Shop Drawings															
			Detail Drawings	1.4.1	G	M												
			Pump Base Plate And The	1.4.1	G	M												
			Anchoring Bolts															
			SD-03 Product Data															
			Humidity-Controlled Storage	1.5.2														
			Spare Parts	1.6.1														
			Shipping Bills	1.5.1														
			Pump Curves	2.1.3														
			Preliminary Pump Curves	2.1.3														

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CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		35 45 01	Installation and Erection	3.1.1														
			Instructions Manual															
			Field Tests	3.2														
			Impeller Weight	2.4.8.2														
			SD-05 Design Data															
			Stress-Relieving Procedure	2.3.3.1	G	M												
			Baseplates and the Anchoring	2.7	G	M												
			Bolts															
			SD-06 Test Reports															
			Witness Test	2.6.2.6	G	M												
			Factory Test	2.6.2	G	M												
			Balancing Procedure	2.4.8.2	G	M												
			Results Of Impeller Balancing	2.4.8.2	G	M												
			SD-07 Certificates															
			Qualified Welders	1.4.2														
			Examination Procedure And	2.3.4														
			Qualification Of The Examiner															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.1.1	G	R												
			Instructions Manual															
		46 61 00	SD-02 Shop Drawings															
			Filtration System	2.1	G	M												
			SD-03 Product Data															
			Posting Framed Instructions	3.11														
			Qualifications	1.3														

SUBMITTAL REGISTER

CONTRACT NO.
W912ER-14-D-0003

TITLE AND LOCATION
P-964 - Bahrain Shore to Ship Utilities

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # PARAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		46 61 00	Media	2.4															
			Spare Parts	1.5															

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS
11/15 (13 July 2020 MED)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.22	(2007; R 2012) Safety Requirements for Rope-Guided and Non-Guided Workers' Hoists
ASSE/SAFE A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE A10.44	(2014) Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations
ASSE/SAFE Z244.1	(2003; R 2014) Control of Hazardous Energy Lockout/Tagout and Alternative Methods
ASSE/SAFE Z359.0	(2012) Definitions and Nomenclature Used for Fall Protection and Fall Arrest
ASSE/SAFE Z359.1	(2016) The Fall Protection Code
ASSE/SAFE Z359.11	(2014) Safety Requirements for Full Body Harnesses
ASSE/SAFE Z359.12	(2009) Connecting Components for Personal Fall Arrest Systems
ASSE/SAFE Z359.13	(2013) Personal Energy Absorbers and Energy Absorbing Lanyards
ASSE/SAFE Z359.14	(2014) Safety Requirements for Self-Retracting Devices for Personal Fall Arrest and Rescue Systems
ASSE/SAFE Z359.15	(2014) Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems
ASSE/SAFE Z359.2	(2007) Minimum Requirements for a Comprehensive Managed Fall Protection Program
ASSE/SAFE Z359.3	(2007) Safety Requirements for Positioning and Travel Restraint Systems
ASSE/SAFE Z359.4	(2013) Safety Requirements for

	Assisted-Rescue and Self-Rescue Systems, Subsystems and Components
ASSE/SAFE Z359.6	(2009) Specifications and Design Requirements for Active Fall Protection Systems
ASSE/SAFE Z359.7	(2011) Qualification and Verification Testing of Fall Protection Products
ASSE/SAFE Z490.1	(2009) Criteria for Accepted Practices in Safety, Health, and Environmental Training

ASME INTERNATIONAL (ASME)

ASME B30.20	(2013; INT Oct 2010 - May 2012) Below-the-Hook Lifting Devices
ASME B30.22	(2016) Articulating Boom Cranes
ASME B30.23	(2011) Personnel Lifting Systems Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ASME B30.26	(2015; INT Jun 2010 - Jun 2014) Rigging Hardware
ASME B30.3	(2016) Tower Cranes
ASME B30.5	(2014) Mobile and Locomotive Cranes
ASME B30.7	(2011) Winches
ASME B30.8	(2015) Floating Cranes and Floating Derricks
ASME B30.9	(2014; INT Feb 2011 - Nov 2013) Slings

ASTM INTERNATIONAL (ASTM)

ASTM F855	(2015) Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1048	(2003) Guide for Protective Grounding of Power Lines
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2018; TIA 18-1) Standard for Portable Fire Extinguishers
NFPA 241	(2013; Errata 2015) Standard for

	Safeguarding Construction, Alteration, and Demolition Operations
NFPA 51B	(2014) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code
NFPA 70E	(2018; TIA 18-1; TIA 81-2) Standard for Electrical Safety in the Workplace

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-1019	(2012; R 2016) Standard for Installation, Alteration and Maintenance of Antenna Supporting Structures and Antennas
TIA-222	(2005G; Add 1 2007; Add 2 2009; Add 3 2014; Add 4 2014; R 2014; R 2016) Structural Standards for Steel Antenna Towers and Antenna Supporting Structures

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.147	The Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1910.333	Selection and Use of Work Practices
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1915.89	Control of Hazardous Energy (Lockout/Tags-Plus)
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes and Derricks in Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.450	Scaffolds
29 CFR 1926.500	Fall Protection

29 CFR 1926.552	Material Hoists, Personal Hoists, and Elevators
29 CFR 1926.553	Base-Mounted Drum Hoists
CPL 02-01-056	(2014) Inspection Procedures for Accessing Communication Towers by Hoist
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

1.2.1 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures with regards to such hazards.

1.2.2 Competent Person, Confined Space

The CP, Confined Space, is a person meeting the competent person requirements as defined EM 385-1-1 Appendix Q, with thorough knowledge of OSHA’s Confined Space Standard, 29 CFR 1910.146, and designated in writing to be responsible for the immediate supervision, implementation and monitoring of the confined space program, who through training, knowledge and experience in confined space entry is capable of identifying, evaluating and addressing existing and potential confined space hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.3 Competent Person, Cranes and Rigging

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.4 Competent Person, Excavation/Trenching

A CP, Excavation/Trenching, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and 29 CFR 1926, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the excavation/trenching program, who through training, knowledge and experience in excavation/trenching is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.5 Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person

requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSE/SAFE Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.6 Competent Person, Scaffolding

The CP, Scaffolding is a person meeting the competent person requirements in EM 385-1-1 Appendix Q, and designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the scaffolding program. The CP for Scaffolding has enough training, knowledge and experience in scaffolding to correctly identify, evaluate and address existing and potential hazards and also has the authority to take prompt corrective measures with regard to these hazards. CP qualifications must be documented and include experience on the specific scaffolding systems/types being used, assessment of the base material that the scaffold will be erected upon, load calculations for materials and personnel, and erection and dismantling. The CP for scaffolding must have a documented, minimum of 8-hours of scaffold training to include training on the specific type of scaffold being used (e.g. mast-climbing, adjustable, tubular frame), in accordance with EM 385-1-1 Section 22.B.02.

1.2.7 Competent Person (CP) Trainer

A competent person trainer as defined in EM 385-1-1 Appendix Q, who is qualified in the material presented, and who possesses a working knowledge of applicable technical regulations, standards, equipment and systems related to the subject matter on which they are training Competent Persons. A competent person trainer must be familiar with the typical hazards and the equipment used in the industry they are instructing. The training provided by the competent person trainer must be appropriate to that specific industry. The competent person trainer must evaluate the knowledge and skills of the competent persons as part of the training process.

1.2.8 High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and confined space entry.

1.2.9 High Visibility Accident

A High Visibility Accident is any mishap which may generate publicity or high visibility.

1.2.10 Load Handling Equipment (LHE)

LHE is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

1.2.11 Medical Treatment

Medical Treatment is treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

1.2.12 Near Miss

A Near Miss is a mishap resulting in no personal injury and zero property damage, but given a shift in time or position, damage or injury may have occurred (e.g., a worker falls off a scaffold and is not injured; a crane swings around to move the load and narrowly misses a parked vehicle).

1.2.13 Operating Envelope

The Operating Envelope is the area surrounding any crane or load handling equipment. Inside this "envelope" is the crane, the operator, riggers and crane walkers, other personnel involved in the operation, rigging gear between the hook, the load, the crane's supporting structure (i.e. ground or rail), the load's rigging path, the lift and rigging procedure.

1.2.14 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.2.15 Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the requirements of EM 385-1-1 Appendix Q, and ASSE/SAFE Z359.0, with a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, and evaluating and specifying fall protection and rescue systems.

1.2.16 USACE Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

1.2.17 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

A LHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents, even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, or roll over). Document an LHE mishap using the Crane High Hazard working group mishap reporting form.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G M

SD-06 Test Reports

Monthly Exposure Reports

Notifications and Reports

Accident Reports; G M

Epidemic/Pandemic Reporting; G M

LHE Inspection Reports

SD-07 Certificates

Crane Operators/Riggers

Standard Lift Plan; G M

Critical Lift Plan ; G M

Activity Hazard Analysis (AHA)

Confined Space Entry Permit

Hot Work Permit

Certificate of Compliance

1.4 MONTHLY EXPOSURE REPORTS

Provide a Monthly Exposure Report and attach to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both Prime and subcontractor. This report shall record hours worked only for employees that are exposed to hazards on a construction site while working on the site. Anyone involved with the project in an office not on the construction site shall not be counted in this report. Failure to submit the report may result in retention of up to 10 percent of the voucher.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of OSHA 29 CFR 1926, USACE EM 385-1-1, and most recent version of host nation (or sub-jurisdiction, e.g.: province, county, city, etc.) health and safety constitutions, laws, statutes, regulations, codes, guidance, standards,

ordinances, criteria, provisions, rules, and policy (for purposes of this paragraph, these are collectively referred to as "Regulatory Requirements"). Submit matters of interpretation of Regulatory Requirements to the Contracting Officer's Representative for resolution before starting work. Where the Regulatory Requirements vary or conflict, the most stringent requirements govern. In the event of a conflict between the Regulatory Requirements and other portions of this contract, submit such conflict to the Contracting Officer's Representative for resolution before starting work.

1.6 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

Provide an SSHO that meets the requirements of EM 385-1-1 Section 1. The SSHO must ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Alternate SSHO must be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO and Alternate SSHO must have the required training, experience, and qualifications in accordance with EM 385-1-1 Section 01.A.17, and all associated sub-paragraphs.

If the SSHO is off-site for a period longer than 24 hours, an equally-qualified alternate SSHO must be provided and must fulfill the same roles and responsibilities as the primary SSHO. When the SSHO is temporarily (up to 24 hours) off-site, a Designated Representative (DR), as identified in the AHA may be used in lieu of an Alternate SSHO, and must be on the project site at all times when work is being performed. Note that the DR is a collateral duty safety position, with safety duties in addition to their full time occupation.

1.6.1.1.1 Additional Site Safety and Health Officer (SSHO) Requirements and Duties

The SSHO shall be a ful-time responsibility with no other duties. The SSHO may not serve as the Quality Control Manager. The SSHO may not serve as the Superintendent.

The SSHO must have completed a 40 hour contract safety awareness course based on the content and principles of EM 385-1-1, and instructed in accordance with the guidelines of ASSE/SAFE Z490.1, by a trainer meeting the qualifications of paragraph QUALIFIED TRAINER REQUIREMENTS. If the SSHO does not have a current certification, certification must be obtained within 60 days, maximum, of contract award.

1.6.1.2 Competent Person Qualifications

Provide Competent Persons in accordance with EM 385-1-1, Appendix Q and herein. Competent Persons for high risk activities include confined space, cranes and rigging, excavation/trenching, fall protection, and electrical work. The CP for these activities must be designated in writing, and meet the requirements for the specific activity (i.e. competent person, fall protection).

The Competent Person identified in the Contractor's Safety and Health Program and accepted Accident Prevention Plan, must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the the Contracting Officer for information in consultation with the Safety Office.

1.6.1.2.1 Competent Person for Confined Space Entry

Provide a Confined Space (CP) Competent Person who meets the requirements of EM 385-1-1, Appendix Q, and herein. The CP for Confined Space Entry must supervise the entry into each confined space in accordance with EM 385-1-1, Section 34.

1.6.1.2.2 Competent Person for Scaffolding

Provide a Competent Person for Scaffolding who meets the requirements of EM 385-1-1, Section 22.B.02 and herein.

1.6.1.2.3 Competent Person for Fall Protection

Provide a Competent Person for Fall Protection who meets the requirements of EM 385-1-1, Section 21.C.04, 21.B.03, and herein.

1.6.1.3 Qualified Trainer Requirements

Individuals qualified to instruct the 40 hour contract safety awareness course, or portions thereof, must meet the definition of a Competent Person Trainer, and, at a minimum, possess a working knowledge of the following subject areas: EM 385-1-1, Electrical Standards,Lockout/Tagout, Fall Protection, Confined Space Entry for Construction; Excavation, Trenching and Soil Mechanics, and Scaffolds in accordance with 29 CFR 1926.450, Subpart L.

Instructors are required to:

a. Prepare class presentations that cover construction-related safety requirements.

b. Ensure that all attendees attend all sessions by using a class roster signed daily by each attendee. Maintain copies of the roster for at least five (5) years. This is a certification class and must be attended 100 percent. In cases of emergency where an attendee cannot make it to a session, the attendee can make it up in another class session for the same subject.

c. Update training course materials whenever an update of the EM 385-1-1 becomes available.

d. Provide a written exam of at least 50 questions. Students are required to answer 80 percent correctly to pass.

e. Request, review and incorporate student feedback into a continuous course improvement program.

1.6.1.4 Crane Operators/Riggers

Provide Operators, Signal Persons, and Riggers meeting the requirements in EM 385-1-1, Section 15.B for Riggers and Section 16.B for Crane Operators

and Signal Persons. Provide proof of current qualification.

1.6.2 Personnel Duties

1.6.2.1 Duties of the Site Safety and Health Officer (SSHO)

The SSHO must:

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.

b. Conduct mishap investigations and complete required accident reports. Report mishaps and near misses.

c. Use and maintain OSHA's Form 300 to log work-related injuries and illnesses occurring on the project site for Prime Contractors and subcontractors, and make available to the Contracting Officer upon request. Post and maintain the Form 300A on the site Safety Bulletin Board.

d. Maintain applicable safety reference material on the job site.

e. Attend the pre-construction conference, pre-work meetings including preparatory meetings, and periodic in-progress meetings.

f. Review the APP and AHAs for compliance with EM 385-1-1, and approve, sign, implement and enforce them.

g. Establish a Safety and Occupational Health (SOH) Deficiency Tracking System that lists and monitors outstanding deficiencies until resolution.

h. Ensure subcontractor compliance with safety and health requirements.

i. Maintain a list of hazardous chemicals on site and their material Safety Data Sheets (SDS).

j. Maintain a weekly list of high hazard activities involving energy, equipment, excavation, entry into confined space, and elevation, and be prepared to discuss details during QC Meetings.

k. Provide and keep a record of site safety orientation and indoctrination for Contractor employees, subcontractor employees, and site visitors.

Superintendent, QC Manager, and SSHO are subject to dismissal if the above duties are not being effectively carried out. If Superintendent, QC Manager, or SSHO are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant

role in accident prevention on the project must attend the preconstruction conference. This includes the project superintendent, Site Safety and Occupational Health officer, quality control manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, and Government review of AHAs to preclude project delays.

c. Deficiencies in the submitted APP, identified during the Contracting Officer's review, must be corrected, and the APP re-submitted for review prior to the start of construction. Work is not permitted to begin until an APP is established that is acceptable to the Contracting Officer.

1.6.3.2 Safety Meetings

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors on the project location. The SSHO, supervisors, foremen, or CDSOs must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Contracting Officer on request. Notify the Contracting Officer of all scheduled meetings 7 calendar days in advance.

1.7 ACCIDENT PREVENTION PLAN (APP)

A qualified person must prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of EM 385-1-1, Appendix A, and as supplemented herein. Cover all paragraph and subparagraph elements in EM 385-1-1, Appendix A. A copy of the A-02 Form is provided as Exhibit A to this section. This checklist serves as a guide only, it does not replace or eliminate the need to comply with the requirements set forth in Engineering Manual 385-1-1, Safety and Health Requirements Manual, dated 30 Nov 2014. The references included in this checklist correspond to the applicable sections of EM 385-1-1.

The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and health program referenced in the APP in the applicable APP element, and made site-specific. Describe the methods to evaluate past safety performance of potential subcontractors in the selection process. Also, describe innovative methods used to ensure and monitor safe work practices of subcontractors. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance,

coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP must be signed by an officer of the firm (Prime Contractor senior person), the individual preparing the APP, the on-site superintendent, the designated SSHO, the Contractor Quality Control Manager, and any designated Certified Safety Professional (CSP) or Certified Health Physicist (CIH). The SSHO must provide and maintain the APP and a log of signatures by each subcontractor foreman, attesting that they have read and understand the APP, and make the APP and log available on-site to the Contracting Officer. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

The following shall be submitted with the APP:

a. A copy of the letter to the Site Safety Health Officer (SSHO) signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the SSHO including authority to stop work which is not in compliance with the most stringent OSHA, EM385-1-1, or Host Nation safety requirements.

b. A description of the safety organization, including a chart showing lines of authority that the SSHO Manager who reports to a senior project (or corporate) official.

Note: It is the contractors responsibility to protect the Safety and Health of its workforce to include Labor Camps. In the event of an epidemic/pandemic, contractor must submit a revised APP within seven calendar days of notification by the Contracting Officer. The revised APP will include a site specific monitoring plan that would be in effect during an epidemic/pandemic type event. The plan will addresses at a minimum the following elements.

- Procedures for periodic sanitation inspections.

- Procedures for disinfecting project site to include high traffic areas in accordance with the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) guidelines (whichever is more stringent).

- Site specific measures to practice social distancing while working on the project.

- Employee training on the signs, symptoms, and protection measures in accordance with CDC/WHO guidelines (whichever is more stringent).

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once reviewed and accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP is cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified. Continuously review and amend the APP, as necessary, throughout the life of the contract. Changes to the accepted APP must be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and Quality Control Manager. Incorporate unusual or high-hazard activities

not identified in the original APP as they are discovered. Should any severe hazard exposure (i.e. imminent danger) become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate and remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34), and the environment.

1.7.1 Names and Qualifications

Provide plans in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

a. Names and qualifications (resumes including education, training, experience and certifications) of site safety and health personnel designated to perform work on this project to include the designated Site Safety and Health Officer and other competent and qualified personnel to be used. Specify the duties of each position.

b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; and personal protective equipment and clothing to include selection, use and maintenance.

1.7.2 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.7.2.1 Confined Space Entry Plan

Develop a confined or enclosed space entry plan in accordance with EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

1.7.2.2 Standard Lift Plan (SLP)

Plan lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP in accordance with EM 385-1-1, Section 16.A.03, using Form 16-2 for every lift or series of lifts (if duty cycle or routine lifts are being performed). The SLP must be developed, reviewed and accepted by all personnel involved in the lift in conjunction with the associated AHA. Signature on the AHA constitutes acceptance of the plan. Maintain the SLP on the LHE for the current lift(s) being made. Maintain historical SLPs for a minimum of 3 months.

1.7.2.3 Critical Lift Plan - Crane or Load Handling Equipment

Provide a Critical Lift Plan as required by EM 385-1-1, Section 16.H.01, using Form 16-3. In addition, Critical Lift Plans are required for the following:

a. Lifts over 50 percent of the capacity of barge mounted mobile crane's hoist.

b. When working around energized power lines where the work will get closer than the minimum clearance distance in EM 385-1-1 Table 16-1.

c. For lifts with anticipated binding conditions.

d. When erecting cranes.

1.7.2.3.1 Critical Lift Plan Planning and Schedule

Critical lifts require detailed planning and additional or unusual safety precautions. Develop and submit a critical lift plan to the Contracting Officer 30 calendar days prior to critical lift. Comply with load testing requirements in accordance with EM 385-1-1, Section 16.F.03.

1.7.2.3.2 Lifts of Personnel

In addition to the requirements of EM 385-1-1, Section 16.H.02, for lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400 and EM 385-1-1, Section 16.T.

1.7.2.4 Barge Mounted Mobile Crane Lift Plan

Include an LHE Manufacturer's Floating Service Load Chart in accordance with EM 385-1-1, Section 16.L.03.

1.7.2.5 Multi-Purpose Machines, Material Handling Equipment, and Construction Equipment Lift Plan

Multi-purpose machines, material handling equipment, and construction equipment used to lift loads that are suspended by rigging gear, require proof of authorization from the machine OEM that the machine is capable of making lifts of loads suspended by rigging equipment. Written approval from a qualified registered professional engineer, after a safety analysis is performed, is allowed in lieu of the OEM's approval. Demonstrate that the operator is properly trained and that the equipment is properly configured to make such lifts and is equipped with a load chart.

1.7.2.6 Fall Protection and Prevention (FP&P) Plan

The plan must comply with the requirements of EM 385-1-1, Section 21.D and ASSE/SAFE Z359.2, be site specific, and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 1.8 m. A competent person or qualified person for fall protection must prepare and sign the plan documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Review and revise, as necessary, the Fall Protection and Prevention Plan documentation as conditions change, but at a minimum

every six months, for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.7.2.7 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Section 21.N and ASSE/SAFE Z359.2, and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.7.2.8 Hazardous Energy Control Program (HECP)

Develop a HECP in accordance with EM 385-1-1 Section 12, 29 CFR 1910.147, 29 CFR 1910.333, 29 CFR 1915.89, ASSE/SAFE Z244.1, and ASSE/SAFE A10.44. Submit this HECP as part of the Accident Prevention Plan (APP). Conduct a preparatory meeting and inspection with all effected personnel to coordinate all HECP activities. Document this meeting and inspection in accordance with EM 385-1-1, Section 12.A.02. Ensure that each employee is familiar with and complies with these procedures.

1.7.2.9 Excavation Plan

Identify the safety and health aspects of excavation, and provide and prepare the plan in accordance with EM 385-1-1, Section 25.A and Section 31 00 00 EARTHWORK.

1.7.2.10 Site Demolition Plan

Identify the safety and health aspects, and prepare in accordance with the contract documents.

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

Before beginning each activity, task or Definable Feature of Work (DFOW) involving a type of work presenting hazards not experienced in previous project operations, or where a new work crew or subcontractor is to perform the work, the Contractor(s) performing that work activity must prepare an AHA. AHAs must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the Contracting Officer. AHAs must be signed by the SSHO, Superintendent, QC Manager and the subcontractor Foreman performing the work. Format the AHA in accordance with EM 385-1-1, Section 1 or as directed by the Contracting Officer. Submit the AHA for review at least 15 working days prior to the start of each activity task, or DFOW. The Government reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

AHAs must identify competent persons required for phases involving high risk activities, including confined entry, crane and rigging, excavations, trenching, electrical work, fall protection, and scaffolding.

1.8.1 AHA Management

Review the AHA list periodically (at least monthly) at the Contractor supervisory safety meeting, and update as necessary when procedures, scheduling, or hazards change. Use the AHA during daily inspections by the SSHO to ensure the implementation and effectiveness of the required safety and health controls for that work activity.

1.8.2 AHA Signature Log

Each employee performing work as part of an activity, task or DFOW must review the AHA for that work and sign a signature log specifically maintained for that AHA prior to starting work on that activity. The SSHO must maintain a signature log on site for every AHA. Provide employees whose primary language is other than English, with an interpreter to ensure a clear understanding of the AHA and its contents.

1.9 DISPLAY OF SAFETY INFORMATION

1.9.1 Safety Bulletin Board

Within one calendar day after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, may be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, Section 01.A.07. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.9.2 Safety and Occupational Health (SOH) Deficiency Tracking System

Establish a SOH deficiency tracking system that lists and monitors the status of SOH deficiencies in chronological order. Use the tracking system to evaluate the effectiveness of the APP. A monthly evaluation of the data must be discussed in the QC or SOH meeting with everyone on the project. The list must be posted on the project bulletin board and updated daily, and provide the following information:

a. Date deficiency identified;

b. Description of deficiency;

c. Name of person responsible for correcting deficiency;

d. Projected resolution date;

e. Date actually resolved.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors must arrange for their own emergency medical treatment in accordance with EM 385-1-1. Government has no responsibility to provide emergency medical treatment.

1.12 NOTIFICATIONS and REPORTS

1.12.1 Mishap Notification

Notify the Contracting Officer as soon as practical, but no more than twenty-four hours, after any mishaps, including recordable accidents, incidents, and near misses, as defined in EM 385-1-1 Appendix Q, any report of injury, illness, or any property damage. For LHE or rigging mishaps, notify the Contracting Officer as soon as practical but not more than 4 hours after mishap. The Contractor is responsible for obtaining appropriate medical and emergency assistance and for notifying fire, law enforcement, and regulatory agencies. Immediate reporting is required for electrical mishaps, to include Arc Flash; shock; uncontrolled release of hazardous energy (includes electrical and non-electrical); load handling equipment or rigging; fall from height (any level other than same surface); and underwater diving. These mishaps must be investigated in depth to identify all causes and to recommend hazard control measures.

Within notification include Contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Assist and cooperate fully with the Government's investigation(s) of any mishap.

1.12.2 Epidemic/Pandemic Reporting

Notify the Contracting Officer as soon as practical, but no more than twenty-four hours after any confirmed or presumptive positive contracted virus/illness associated with any epidemic/pandemic. Notification must include firm name, position held/labor category required for both prime contractor(s)(and associated first and second tier subcontractor(s), the geographic location of the individual's accommodation or residence, whether individuals who had sustained contact with the infected individual are being isolated, how many individuals had such sustained contact, and what efforts the contractor has made to have all potentially-exposed individuals tested for the virus/illness associated with the epidemic/pandemic. In addition, contractor must also report illness of employees who are not directly supporting a USACE contract but live in a contractor camp along with personnel who do support USACE contracts and are confirmed or presumed to have contracted epidemic/pandemic type virus/illness.

1.12.3 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, property damage, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable USACE Accident Report Form 3394, and provide the report to

the Contracting Officer within 5 calendar days of the accident. The Contracting Officer will provide copies of any required or special forms.

b. Near Misses: For Army projects, report all "Near Misses" to the GDA, using local mishap reporting procedures, within 24 hrs. The Contracting Officer will provide the Contractor the required forms. Near miss reports are considered positive and proactive Contractor safety management actions.

c. Conduct an accident investigation for any load handling equipment accident (including rigging accidents) to establish the root cause(s) of the accident. Complete the LHE Accident Report (Crane and Rigging Accident Report) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the Contracting Officer. The Contracting Officer will provide a blank copy of the accident report form.

1.12.4 LHE Inspection Reports

Submit LHE inspection reports required in accordance with EM 385-1-1 and as specified herein with Daily Reports of Inspections.

1.12.5 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Provide a FORM 16-1 Certificate of Compliance for LHE entering an activity under this contract and in accordance with EM 385-1-1. Post certifications on the crane.

Develop a Standard Lift Plan (SLP) in accordance with EM 385-1-1, Section 16.H.03 using Form 16-2 Standard Pre-Lift Crane Plan/Checklist for each lift planned. Submit SLP to the Contracting Officer for approval within 15 calendar days in advance of planned lift.

1.13 HOT WORK

1.13.1 Permit and Personnel Requirements

Submit and obtain a written permit prior to performing "Hot Work" (i.e. welding or cutting) or operating other flame-producing/spark producing devices as directed by the Contracting Officer. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two 9 kg 4A:20 BC rated extinguishers for normal "Hot Work". The extinguishers must be current inspection tagged, and contain an approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch must be trained in accordance with NFPA 51B and remain on-site for a minimum of one hour after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency point of contact phone number. REPORT ANY FIRE, NO MATTER HOW SMALL, TO THE RESPONSIBLE POINT OF CONTACT IMMEDIATELY.

1.13.2 Work Around Flammable Materials

Obtain permit approval from a NFPA Certified Marine Chemist for "HOT WORK" within or around flammable materials (such as fuel systems or welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, or vaults) that have the potential for flammable or explosive atmospheres.

Whenever these materials, except beryllium and chromium (VI), are encountered in indoor operations, local mechanical exhaust ventilation systems that are sufficient to reduce and maintain personal exposures to within acceptable limits must be used and maintained in accordance with manufacturer's instruction and supplemented by exceptions noted in EM 385-1-1, Section 06.H

1.14 CONFINED SPACE ENTRY REQUIREMENTS

Confined space entry must comply with Section 34 of EM 385-1-1, OSHA 29 CFR 1926, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, and OSHA Directive CPL 2.100. Any potential for a hazard in the confined space requires a permit system to be used.

1.14.1 Entry Procedures

Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. Comply with EM 385-1-1, Section 34 for entry procedures. Hazards pertaining to the space must be reviewed with each employee during review of the AHA.

1.14.2 Forced Air Ventilation

Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its action level.

1.14.3 Sewer Wet Wells

Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

1.14.4 Rescue Procedures and Coordination with Local Emergency Responders

Develop and implement an on-site rescue and recovery plan and procedures. The rescue plan must not rely on local emergency responders for rescue from a confined space.

1.15 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be worn or carried/available on each person. Mandatory PPE includes:

a. Hard Hat

b. Long Pants

c. Appropriate Safety Shoes

d. Appropriate Class Reflective Vests

3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable means). The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. An employee check-in/check-out communication procedure must be developed to ensure employee safety.

3.1.2 Hazardous Material Use

Each hazardous material must receive approval from the Contracting Officer or their designated representative prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.

3.1.3 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited. The Contracting Officer, upon

written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.4 Unforeseen Hazardous Material

Contract documents identify materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during construction operations, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to FAR 52.243-4 Changes and FAR 52.236-2 Differing Site Conditions.

3.2 UTILITY OUTAGE REQUIREMENTS

Apply for utility outages at least thirty (30) calendar days in advance. At a minimum, the written request must include the location of the outage, utilities being affected, duration of outage, any necessary sketches, and a description of the means to fulfill energy isolation requirements in accordance with EM 385-1-1, Section 11.A.02 (Isolation). Some examples of energy isolation devices and procedures are highlighted in EM 385-1-1, Section 12.D. In accordance with EM 385-1-1, Section 12.A.01, where outages involve Government or Utility personnel, coordinate with the Government on all activities involving the control of hazardous energy.

These activities include, but are not limited to, a review of HECP and HEC procedures, as well as applicable Activity Hazard Analyses (AHAs). In accordance with EM 385-1-1, Section 11.A.02 and NFPA 70E,work on energized electrical circuits must not be performed without prior government authorization. Government permission is considered through the permit process and submission of a detailed AHA. Energized work permits are considered only when de-energizing introduces additonal or increased hazard or when de-energizing is infeasible.

3.3 OUTAGE COORDINATION MEETING

After the utility outage request is approved and prior to beginning work on the utility system requiring shut-down, conduct a pre-outage coordination meeting in accordance with EM 385-1-1, Section 12.A. This meeting must include the Prime Contractor, the Prime and subcontractors performing the work, the Contracting Officer, and the Installation representative and/or Public Utilities representative when applicable. All parties must fully coordinate HEC activites with one another. During the coordination meeting, all parties must discuss and coordinate on the scope of work, HEC procedures (specifically, the lock-out/tag-out procedures for worker and utility protection), the AHA, assurance of trade personnel qualifications, identification of competent persons, and compliance with HECP training in accordance with EM 385-1-1, Section 12.C. Clarify when personal protective equipment is required during switching operations, inspection, and verification.

3.4 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Provide and operate a Hazardous Energy Control Program (HECP) in accordance with EM 385-1-1 Section 12, 29 CFR 1910.333, 29 CFR 1915.89, ASSE/SAFE A10.44, NFPA 70E, and paragraph HAZARDOUS ENERGY CONTROL PROGRAM (HECP).

3.4.1 Safety Preparatory Inspection Coordination Meeting with the Government or Utility

For electrical distribution equipment that is to be operated by Government or Utility personnel, the Prime Contractor and the subcontractor performing the work must attend the safety preparatory inspection coordination meeting, which will also be attended by the Contracting Officer's Representative, and required by EM 385-1-1, Section 12.A.02. The meeting will occur immediately preceding the start of work and following the completion of the outage coordination meeting. Both the safety preparatory inspection coordination meeting and the outage coordination meeting must occur prior to conducting the outage and commencing with lockout/tagout procedures.

3.4.2 Lockout/Tagout Isolation

Where the Government or Utility performs equipment isolation and lockout/tagout, the Contractor must place their own locks and tags on each energy-isolating device and proceed in accordance with the HECP. Before any work begins, both the Contractor and the Government or Utility must perform energy isolation verification testing while wearing required PPE detailed in the Contractor's AHA and required by EM 385-1-1, Sections 05.I and 11.B. Install personal protective grounds, with tags, to eliminate the potential for induced voltage in accordance with EM 385-1-1, Section 12.E.06.

3.4.3 Lockout/Tagout Removal

Upon completion of work, conduct lockout/tagout removal procedure in accordance with the HECP. In accordance with EM 385-1-1, Section 12.E.08, each lock and tag must be removed from each energy isolating device by the authorized individual or systems operator who applied the device. Provide formal notification to the Government (by completing the Government form if provided by Contracting Officer's Representative), confirming that steps of de-energization and lockout/tagout removal procedure have been conducted and certified through inspection and verification. Government or Utility locks and tags used to support the Contractor's work will not be removed until the authorized Government employee receives the formal notification.

3.5 FALL PROTECTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSE/SAFE Z359.2 and EM 385-1-1, Sections 21.A and 21.D.

3.5.1 Training

Institute a fall protection training program. As part of the Fall Protection Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with EM 385-1-1, Section 21.C. Document training and practical application of the competent person in accordance with EM 385-1-1, Section 21.C.04 and ASSE/SAFE Z359.2 in the AHA.

3.5.2 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21.

Provide personal fall protection equipment, systems, subsystems, and components that comply with EM 385-1-1 Section 21.I, 29 CFR 1926.500 Subpart M,ASSE/SAFE Z359.0, ASSE/SAFE Z359.1, ASSE/SAFE Z359.2, ASSE/SAFE Z359.3, ASSE/SAFE Z359.4, ASSE/SAFE Z359.6, ASSE/SAFE Z359.7, ASSE/SAFE Z359.11, ASSE/SAFE Z359.12, ASSE/SAFE Z359.13, ASSE/SAFE Z359.14, and ASSE/SAFE Z359.15.

3.5.2.1 Additional Personal Fall Protection

In addition to the required fall protection systems, other protection such as safety skiffs, personal floatation devices, and life rings, are required when working above or next to water in accordance with EM 385-1-1, Sections 21.O through 21.O.06. Personal fall protection systems and equipment are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall protection systems are required when operating other equipment such as scissor lifts. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, travel, or while performing work.

3.5.2.2 Personal Fall Protection Harnesses

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabiners must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 1633 kg in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 1.8 m, unless the proper energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest system. All full body harnesses must be equipped with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance in accordance with EM 385-1-1, Section 21.I.06.

3.5.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 1.8 m of an edge, on a roof having a slope less than or equal to 4:12 (vertical to horizontal), protect personnel from falling by use of personal fall arrest/restraint systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized. Provide in accordance with 29 CFR 1926.500.

(2) For work greater than 1.8 m from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and EM 385-1-1, Section L.

b. Steep-Sloped Roofs: Work on a roof having a slope greater than 4:12 (vertical to horizontal) requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also applies to residential or housing type construction.

3.5.4 Horizontal Lifelines (HLL)

Provide HLL in accordance with EM 385-1-1, Section 21.I.08.d.2. Commercially manufactured horizontal lifelines (HLL) must be designed, installed, certified and used, under the supervision of a qualified person, for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500). The competent person for fall protection may (if deemed appropriate by the qualified person) supervise the assembly, disassembly, use and inspection of the HLL system under the direction of the qualified person. Locally manufactured HLLs are not acceptable unless they are custom designed for limited or site specific applications by a Registered Professional Engineer who is qualified in designing HLL systems.

3.5.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1, Section 21.F.01 and 29 CFR 1926 Subpart M.

3.5.6 Rescue and Evacuation Plan and Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue or assisted-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP). The plan must comply with the requirements of EM 385-1-1, ASSE/SAFE Z359.2, and ASSE/SAFE Z359.4.

3.6 WORK PLATFORMS

3.6.1 Scaffolding

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Comply with the following requirements:

a. Scaffold platforms greater than 6 m in height must be accessed by use of a scaffold stair system.

b. Ladders commonly provided by scaffold system manufacturers are prohibited for accessing scaffold platforms greater than 6 m maximum in height.

c. An adequate gate is required.

d. Employees performing scaffold erection and dismantling must be qualified.

e. Scaffold must be capable of supporting at least four times the maximum intended load, and provide appropriate fall protection as delineated in the accepted fall protection and prevention plan.

f. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.

g. Special care must be given to ensure scaffold systems are not overloaded.

h. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited. The first tie-in must be at the height equal to 4 times the width of the smallest dimension of the scaffold base.

i. Scaffolding other than suspended types must bear on base plates upon wood mudsills (51 mm x 254 mm x 203 mm minimum) or other adequate firm foundation.

j. Scaffold or work platform erectors must have fall protection during the erection and dismantling of scaffolding or work platforms that are more than 1.83 meters.

k. Delineate fall protection requirements when working above 1.83 meters or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.6.2 Elevated Aerial Work Platforms (AWPs)

Workers must be anchored to the basket or bucket in accordance with manufacturer's specifications and instructions (anchoring to the boom may only be used when allowed by the manufacturer and permitted by the CP). Lanyards used must be sufficiently short to prohibit worker from climbing out of basket. The climbing of rails is prohibited. Lanyards with built-in shock absorbers are acceptable. Self-retracting devices are not acceptable. Tying off to an adjacent pole or structure is not permitted unless a safe device for 100 percent tie-off is used for the transfer.

Use of AWPs must be operated, inspected, and maintained as specified in

the operating manual for the equipment and delineated in the AHA. Operators of AWPs must be designated as qualified operators by the Prime Contractor. Maintain proof of qualifications on site for review and include in the AHA.

3.7 EQUIPMENT

3.7.1 Material Handling Equipment (MHE)

a. Material handling equipment such as forklifts must not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions. Material handling equipment fitted with personnel work platform attachments are prohibited from traveling or positioning while personnel are working on the platform.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions. Material Handling Equipment Operators must be trained in accordance with OSHA 29 CFR 1910, Subpart N.

c. Operators of forklifts or power industrial trucks must be licensed in accordance with OSHA.

3.7.2 Load Handling Equipment (LHE)

The following requirements apply. In exception, these requirements do not apply to commercial truck mounted and articulating boom cranes used solely to deliver material and supplies (not prefabricated components, structural steel, or components of a systems-engineered metal building) where the lift consists of moving materials and supplies from a truck or trailer to the ground; to cranes installed on mechanics trucks that are used solely in the repair of shore-based equipment; to crane that enter the activity but are not used for lifting; nor to other machines not used to lift loads suspended by rigging equipment. However, LHE accidents occurring during such operations must be reported.

a. Equip cranes and derricks as specified in EM 385-1-1, Section 16.

b. Notify the Contracting Officer 15 working days in advance of any LHE entering the activity, in accordance with EM 385-1-1, Section 16.A.02, so that necessary quality assurance spot checks can be coordinated. Contractor's operator must remain with the crane during the spot check. Rigging gear must comply with OSHA, ASME B30.9 Standards and host country safety standards.

c. Comply with the LHE manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, ASME B30.8 for floating cranes and floating derricks, ASME B30.9 for slings, ASME B30.20 for below the hook lifting devices and ASME B30.26 for rigging hardware.

e. When operating in the vicinity of overhead transmission lines,

operators and riggers must be alert to this special hazard and follow the requirements of EM 385-1-1 Section 11, and ASME B30.5 or ASME B30.22 as applicable.

f. Do not use crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane. Additionally, submit a specific AHA for this work to the Contracting Officer. Ensure the activity and AHA are thoroughly reviewed by all involved personnel.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads, except for employees required to handle the load.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel access where accessible areas of the LHE's rotating superstructure poses a risk of striking, pinching or crushing personnel.

l. Maintain inspection records in accordance by EM 385-1-1, Section 16.D, including shift, monthly, and annual inspections, the signature of the person performing the inspection, and the serial number or other identifier of the LHE that was inspected. Records must be available for review by the Contracting Officer.

m. Maintain written reports of operational and load testing in accordance with EM 385-1-1, Section 16.F, listing the load test procedures used along with any repairs or alterations performed on the LHE. Reports must be available for review by the Contracting Officer.

n. Certify that all LHE operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. At wind speeds greater than 9 m/s, the operator, rigger and lift supervisor must cease all crane operations, evaluate conditions and determine if the lift may proceed. Base the determination to proceed or not on wind calculations per the manufacturer and a reduction in LHE rated capacity if applicable. Include this maximum wind speed determination as part of the activity hazard analysis plan for that operation.

3.7.3 Machinery and Mechanized Equipment

a. Proof of qualifications for operator must be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment must be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into

the AHAs.

3.7.4 Base Mounted Drum Hoists

a. Operation of base mounted drum hoists must comply with EM 385-1-1 and ASSE/SAFE A10.22.

b. Rigging gear must comply with applicable ASME/OSHA standards

c. When used on telecommunication towers, base mounted drum hoists must comply with TIA-1019, TIA-222, ASME B30.7, 29 CFR 1926.552, and 29 CFR 1926.553.

d. When used to hoist personnel, the AHA must include a written standard operating procedure. Operators must have a physical examination in accordance with EM 385-1-1 Section 16.B.05 and trained, at a minimum, in accordance with EM 385-1-1 Section 16.U and 16.T. The base mounted drum hoist must also comply with OSHA Instruction CPL 02-01-056 and ASME B30.23.

e. Material and personnel must not be hoisted simultaneously.

f. Personnel cage must be marked with the capacity (in number of persons) and load limit in kg.

g. Construction equipment must not be used for hoisting material or personnel or with trolley/tag lines. Construction equipment may be used for towing and assisting with anchoring guy lines.

3.7.5 Use of Explosives

Explosives must not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval does not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, must be only where directed and in approved storage facilities. These facilities must be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

3.8 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.8.1 Utility Locations

Provide a third party, independent, private utility locating company to positively identify underground utilities in the work area in addition to any station locating service and coordinated with the station utility department.

3.8.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within 1 meter of the underground system.

3.8.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company must locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the Contractor from meeting this requirement.

3.9 ELECTRICAL

Perform electrical work in accordance with EM 385-1-1, Appendix A, Sections 11 and 12.

3.9.1 Conduct of Electrical Work

As delineated in EM 385-1-1, electrical work is to be conducted in a de-energized state unless there is no alternative method for accomplishing the work. In those cases obtain an energized work permit from the Contracting Officer. The energized work permit application must be accompanied by the AHA and a summary of why the equipment/circuit needs to be worked energized. Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator is allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

When working in energized substations, only qualified electrical workers are permitted to enter. When work requires work near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA. Ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

3.9.2 Qualifications

Electrical work must be performed by QP personnel with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA. Journeyman/Apprentice ratio must be in accordance with Host Nation requirements applicable to where work is being performed.

3.9.3 Arc Flash

Conduct a hazard analysis/arc flash hazard analysis whenever work on or near energized parts greater than 50 volts is necessary, in accordance with NFPA 70E.

All personnel entering the identified arc flash protection boundary must be QPs and properly trained in NFPA 70E requirements and procedures. Unless permitted by NFPA 70E, no Unqualified Person is permitted to approach nearer than the Limited Approach Boundary of energized conductors and circuit parts. Training must be administered by an electrically qualified source and documented.

3.9.4 Grounding

Ground electrical circuits, equipment and enclosures in accordance with NFPA 70 and IEEE C2 to provide a permanent, continuous and effective path to ground unless otherwise noted by EM 385-1-1.

Check grounding circuits to ensure that the circuit between the ground and a grounded power conductor has a resistance low enough to permit sufficient current flow to allow the fuse or circuit breaker to interrupt the current.

3.9.5 Testing

Temporary electrical distribution systems and devices must be inspected, tested and found acceptable for Ground-Fault Circuit Interrupter (GFCI) protection, polarity, ground continuity, and ground resistance before initial use, before use after modification and at least monthly. Monthly inspections and tests must be maintained for each temporary electrical distribution system, and signed by the electrical CP or QP.

3.10 EXHIBIT

Exhibit A - A-02 - Accident Prevention Plan Checklist

-- End of Section --

Form A-02
U.S. Army Corps of Engineers
Accident Prevention Plan Checklist

Date of Inspection

Location (Plant or Facility)	Contract Number
Contractor Name	Project Name
Inspector Name (Print)	Inspector Signature

This checklist serves as a guide only, it does not replace or eliminate the need to comply with the requirements set forth in Engineering Manual 385-1-1, Safety and Health Requirements Manual, dated 30 Nov 2014. The references included in this checklist correspond to the applicable sections of EM 385-1-1.

Item Description	Yes	No	N/A	Remarks (Any NO or N/A item)
a. Signature sheet				
1. Includes the name, title, signature, telephone number, and qualifications of the Plan Preparer (*Qualified person, i.e. corporate safety staff person, QC*)				
2. Includes the name, title, signature, telephone number, and qualifications of the Plan Approver (*e.g. owner, company president, regional vice president*) (HTRW activities require approval of a Certified Industrial Hygienist, a Certified Safety Professional may approve the plan for operations involving UST removal where contaminants are known to be petroleum, oils, or lubricants).				
3. Includes the name(s), title(s), signature(s), telephone number(s), and qualifications for Plan Concurrence (provide concurrence of other applicable corporate and project personnel (contractor)) (*e.g. Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional, project QC.*)				
b. Background information				
1. Includes the Contractor Name.				
2. Includes the Contract Number.				
3. Includes the Project Name.				
4a. Includes the Brief Project Description.				
4b. Includes a Discription of the Work to be Performed.				
4c. Includes the Location of the Project (map).				
4d. Includes the Equipment to be Used.				
4e. Includes the Anticipated High Risk Activities.				
5. Includes the Major Phases of Work Anticipated. *(Within these major phases of work identified, activities [includes Definable features of Work (DFOWs) and tasks] to be performed that will require an AHA shall be specifically highlighted. This information can then be used by QC, QA and Safety personnel to track AHA submittals. The AHAs for these activities, tasks of DFOWs are NOT submitted at this time (AHAs created/submitted at this time would not be activity-specific as they are intended to be). > See Sections 01.A.14 and 01.A.15.)*				

Form A-02
U.S. Army Corps of Engineers
Accident Prevention Plan Checklist (cont'd)

Date of Inspection

Item Description	Yes	No	N/A	Remarks (Any NO or N/A item)
c. Statement of Safety and Health Policy.				
1. Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. (*In addition to the corporate policy statement, a copy of the corporate safety program may provide a portion of the information required by the accident prevention plan*.)				
2. Includes Contractor's written safety program goals.				
3. Includes Contractor's written safety program objectives.				
4. Includes the Contractor Accident Experience (*Copy of OSHA 300 Forms, or equivalent documentation*).				
d. Responsibilities and Lines of Authority.				
1. Includes statement of the employer's ultimate responsibility for the implementation of his SOH program for his own employees, all sub-contractors and all others on the worksite (includes the strict enforcement of the program).				
2. Includes the identification and accountability of personnel responsible for safety and health at both the corporate and project level – including their resumes. Qualifications shall be in accordance with Section 01.A.17. *(Only official OSHA 30-Hour cards will be accepted or, if equivalent training is provided, appropriate instructor qualifications.)*				
3. Includes equivalent training to the OSHA 30-Hour classes is being presented as qualification, the training shall cover, as a minimum, the areas discussed in Appendix A, Section 3.d.3.(a-d).				
4. Includes the names of Competent (CP) and/or Qualified Person(s) (QP) and proof of competency/qualification to meet specific OSHA CP/QP requirements. *(Must include copies of proof of CP/QP).*				
5. Includes requirements and details of the employer's Risk Management Process. *(USACE uses the Activity Hazard Analysis (AHA) as part of a total risk management process. Contractors and other individual employer's may use the AHAs or their own version [Job Safety Analyses (JSAs), Job Hazard Analyses (JHAs), or similar Risk Management assessment tools]. These documents are considered equivalent to, and acceptable substitutes for, the USACE's AHA provided the data collected is the same as that required by the AHA.)*				
6. Includes requirements for initial activity-specific AHAs to be submitted and accepted at preparatory meetings, prior to work being performed;				
7. Includes requirements that no work by the Contractor shall be performed unless a designated Competent Person/SSHO is present on the job site.				
8. Includes policies and procedures regarding non-compliance with safety requirements (to include disciplinary actions for violation of safety requirements).				
9. Lines of authority.				
10. Includes written company procedures for holding managers and supervisors accountable for safety.				

Form A-02
U.S. Army Corps of Engineers
Accident Prevention Plan Checklist (cont'd)

Date of Inspection

Item Description	Yes	No	N/A	Remarks (Any NO or N/A item)
e. Subcontractors and Suppliers.				
1. Includes the list of subcontractors and suppliers. *(If not known at the time of initial APP submittal, the contractor shall include the following statement in their initial APP: "The subcontractors for the following DFOWs/activities are not known at this time, but additional information will be submitted to the APP for acceptance prior to the start of any activities listed")*				
2. Includes safety responsibilities of subcontractors and suppliers.				
f. Training				
1. Includes requirements for new hire SOH orientation training at the time of initial hire of each new employee.				
2. Includes requirements for mandatory training and certifications that are applicable to this project (*e.g., explosive actuated tools, confined space entry, crane operator, diver, vehicle operator, HAZWOPER training and certification, PPE*) and any requirements for periodic retraining / recertification.				
3. Includes procedures for periodic safety and health training for supervisors and employees.				
4. Includes the requirements for emergency response training.				
g. Safety and Health Inspections				
1. Includes specific assignment of responsibilities for a minimum daily jobsite SOH inspection during periods of work activity.				
1a. Includes the name(s) of individual(s) responsible for conducting safety inspections. (*e.g., PM, safety professional, QC, supervisors, employees*)				
1b. Includes proof of inspector's training / qualifications.				
1c. Indicates when inspections will be conducted.				
1d. Indicates procedures for documentation. *(Furnished sample forms upon which inspections will be recorded.)*				
1e. Indicates deficiency tracking system and follow-up procedures.				
2. Includes any external inspections / certifications which may be required. (*e.g., US Coast Guard*)				
h. Mishap Reporting and Investigation				
1. The plan identifies how, when, and who shall complete the Exposure data (man-hours worked).				
2a. The plan identifies how, when, and who shall complete mishap investigations, reports, and logs. *(The contractor shall report, thoroughly investigate, and analyze all mishaps occurring incidentally to an operation, project or facility for which this manual is applicable.)*				
2b. The plan identifies how, when, and who shall make immediate notification of major mishaps. *(Mishaps shall be reported as soon as possible but not more than 24 hours afterwards to the KO/COR.)*				
2c. Includes how, when, and who will provide notice to the KO/COR when corrective actions are completed. *(Implement corrective actions as soon as reasonably possible.)*				

Form A-02
U.S. Army Corps of Engineers
Accident Prevention Plan Checklist (cont'd)

Date of Inspection

Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable safety and occupational health risks and associated compliance plans. *Using the EM 385-1-1 as a guide, plans, programs, procedures (assessments and evaluations), may include but not be limited to:*

(1)Include a project-specific compliance plan, as applicable to the work being performed, and as identified below. The plans shall incorporate project-wide procedures to control hazards to which the employees of all project employers may be exposed.

(2) These procedures shall be coordinated with all project employers and shall include project-specific, project-wide emergency response and evacuation procedures, PPE requirements, recordkeeping and reporting requirements, and training requirements.

(3) The plans shall be prepared prior to the start of any work activities on the job site (as much as the information can be known at that point in time). The plans shall be updated throughout the life of the project to include changes in personnel, equipment, conditions, etc. Additional revisions shall be incorporated as necessary to reflect changing site conditions, construction methods, personnel roles and responsibilities and construction schedules.

(4) No activity (DFOW) shall be started on site until the APP is revised and submitted to the GDA for acceptance, with the site-specific plans, programs and procedures required to complete the project.

Item Description	Yes	No	N/A	Remarks (Any NO or N/A item)
i. Plans (Programs, Procedures, Assessments, and Evaluations) required by the Safety Manual				
1. Fatigue Management Plan (01.A.20)				
2. Emergency Plans (01.E):				
(a) Procedures & Test (01.E.01)				
(b) Spill Plans (01.E.01, 06.A.02)				
(c) Fire Fighting Plan (01.E.01; 19.A)				
(d) Posting of Emergency Telephone Numbers (01.E.05)				
(e) Man overboard/abandon ship (19.A.04)				
(f) Plan for prevention of alcohol and drug abuse (01.C.02 & Specs)				
3. Site Sanitation/Housekeeping Plan (02.B)				
4. Medical Support Agreement. Outline on-site medical support and off-site medical arrangements including rescue and medical duties for those employees who are to perform them, and the name(s) of on-site Contractor personnel trained in first aid and CPR. A minimum of two employees shall be certified in CPR and first-aid per shift/site (03.A.01, 03.A.03)				
5. Blood-borne Pathogen Program (03.A.05)				
6. Exposure Control Plan (03.A.05)				
7. Automatic External Defibrillator (AED) Program (03.B.04)				
8. Site Layout Plan (04.A)				
9. Access/Haul Road Plan (04.B)				
10. Hearing Conservation Program (05.C)				
11. Respiratory Protection Plan (05.G)				
12. Health Hazard Control Program (06.A)				
13. Hazard Communication Program (06.B.01)				
14. Process Safety Management Plan (06.B.04)				
15. Lead Compliance Plan (06.C.02 & Specifications)				
16. Asbestos Abatement Plan (06.C.03 & Specifications)				

Form A-02
U.S. Army Corps of Engineers
Accident Prevention Plan Checklist (cont'd)

Date of Inspection

Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks and compliance plans. *Using the EM 385-1-1 as a guide, plans, programs, procedures (assessments and evaluations), may include but not be limited to:*

Item Description	Yes	No	N/A	Remarks (Any NO or N/A item)
i. Plans (Programs, Procedures) continued.				
17. Radiation Safety Program (06.F)				
18. Abrasive Blasting Plan (06.I)				
19. Heat Stress Monitoring Plan (HSMP) (06.J.02)				
20. Cold Stress Monitoring Plan (CSMP) (06.J.04)				
21. Indoor Air Quality Management Plan (06.L)				
22. Mold Remediation Plan (06.L.04)				
23. Chromium (VI) Exposure Evaluation (06.M)				
24. Crystalline Silica Assessment (06.N.02)				
25. Lighting Plan for Night Operations (07.A.06)				
26. Traffic Control Plan (08.C.05)				
27. Fire Prevention Plan (09.A.01)				
28. Wild Land Fire Management Plan (09.L)				
29. Arc Flash Hazard Analysis (11.B)				
30. Assured Equipment Grounding Control Program (AEGCP), (11.D.05, Appendix E)				
31. Hazardous Energy Control Program and Procedures (12.A.01)				
32. Standard Pre-Lift Plan – LHE (16.A.03)				
33. Critical Lift Plan – LHE (16.H)				
34. Naval Architectural Analysis – LHE (Floating) (16.L)				
35. Floating Plant Inspection and Certification (19.A.01)				
36. Severe Weather Plan for Marine Activities (19.A.03)				
37. Emergency Plan for Marine Activities (19.A.04)				
38. Man Overboard/Abandon Ship Procedures (19.A.04)				
39. Float Plan for Launches, Motorboats, Skiffs (19.F.04)				
40. Fall Protection and Prevention Plan (21.D)				
41. Demolition/Renovation Plan (to include engineering survey) (23.A)				
42. Rope Access Work Plan (24.H)				
43. Excavation/Trenching Plan (25.A.01)				
44. Fire Prevention and Protection Plan for Underground Construction (26.D.01)				
45. Compressed Air Work Plan for Underground Construction (26.I.01)				
46. Erection and Removal Plan for Formwork and Shoring (27.C)				
47. Precast Concrete Plan (27.D)				

Form A-02
U.S. Army Corps of Engineers
Accident Prevention Plan Checklist (cont'd)

Date of Inspection

Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks and compliance plans. *Using the EM 385-1-1 as a guide, plans, programs, procedures (assessments and evaluations), may include but not be limited to:*

Item Description	Yes	No	N/A	Remarks (Any NO or N/A item)
i. Plans (Programs, Procedures) continued.				
48. Lift-slab Plans (27.E)				
49. Masonry Bracing Plan (27.F.01)				
50. Steel Erection Plan (28.B)				
51. Explosives Safety Site Plan (ESSP) (29.A)				
52. Blasting Plan (29.A; 26.J)				
53. Dive Operations Plan (30.A.14, 30.A.16)				
54. Safe Practices Manual for Diving Activities (30.A.15)				
55. Emergency Management Plan for Diving (30.A.18)				
56. Tree Felling/Maintenance Program (31.A.01)				
57. Aircraft/Airfield Construction Safety & Phasing Plan (CSPP) (32.A.02)				
58. Aircraft/Airfield Safety Plan Compliance Document (SPCD) (32.A.02)				
59. Site Safety and Health Plan (HTRW) (33.B)				
60. Confined Space Entry Procedures (34.A.05)				
61. Confined Space Program (34.A.06)				
j. Risk Management Processes (AHAs). Detailed project-specific hazards and controls shall be provided by Activity Hazard Analysis for each activity (DFOW). No work will begin on an activity (DFOW) until the initial AHA has been accepted by the GDA addressing the project-specific hazards. (01.A.14 & 01.A.15) *Note: USACE uses the Activity Hazard Analysis (AHA) as part of a total risk management process. Contractors and other individual employer's may use the AHAs or their own version [Job Safety Analyses (JSAs), Job Hazard Analyses (JHAs), or similar Risk Management assessment tools]. These documents are considered equivalent to, and acceptable substitutes for, the USACE's AHA provided the data collected is the same as that required by the AHA.*				

Remarks:

Form A-02 U.S. Army Corps of Engineers Accident Prevention Plan Checklist (cont'd)	Date of Inspection

Other Remarks:

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
11/14

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g. ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)
1600 Boston-Providence Hwy
Walpole, MA 02081
Ph: 1-866-956-5888
Fax: 1-866-956-5819
Internet: https://www.airbarrier.org

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: http://www.amca.org

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph: 703-524-8800
Fax: 703-562-1942
Internet: http://www.ahrinet.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209
Ph: 703-358-2960
E-Mail: info@aluminum.org
Internet: http://www.aluminum.org

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Office Square, Suite 550

Schaumburg, IL 60173-4268
Ph: 847-303-5664
Fax: 847-303-5774
E-mail: customerservice@aamanet.org
Internet: http://www.aamanet.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-367-1155
E-mail: info@americanbearings.org
Internet: http://www.americanbearings.org

AMERICAN CONCRETE INSTITUTE (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
Internet: https://www.concrete.org/

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020 or 513-742-6163
Fax: 513-742-3355
E-mail: mail@acgih.org
Internet: http://www.acgih.org

AMERICAN FOREST FOUNDATION (AFF)
American Tree Farm System
2000 M Street, NW, Suite 550
Washington, DC 20036
Ph: 202-765-3660
Fax: 202-827-7924
Email: info@treefarmsystem.org
Internet: https://www.treefarmsystem.org/standards-review

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 847-934-8800
Fax: 847-934-8803
E-mail: aha@hardboard.org
Internet: http://domensino.com/AHA/

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
Ph: 312-670-2400
Fax: 312-670-5403

Bookstore: 800-644-2400
E-mail: aisc@ware-pak.com
Internet: http://www.aisc.org

AMERICAN IRON AND STEEL INSTITUTE (AISI)
25 Massachusetts Avenue, NW Suite 800
Washington, DC 20001
Ph: 202-452-7100
Internet: http://www.steel.org

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)
P.O. Box 210
Germantown, MD 20875-0210
Ph: 301-972-1700
Fax: 301-540-8004
E-mail: alsc@alsc.org
Internet: http://www.alsc.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1899 L Street, NW,11th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: storemanager@ansi.org
Internet: http://www.ansi.org/

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
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U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)
1322 Patterson Ave. SE, Suite 1000
Washington Navy Yard, DC 20374-5065
Ph: 202-685-9387
Internet: http://www.navfac.navy.mil

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542

Ph: 877-854-3577
E-mail: CEC.us@us.ul.com
Internet: http://www.ul.com/
UL Directories available through IHS at http://www.ihs.com

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
2711 LBJ Freeway, Suite 1000
Dallas, TX 75234
Ph: 972-243-3902
Fax: 972-243-3907
E-mail: info@uni-bell.org
Internet: http://www.uni-bell.org

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)
994 Old Eagle School Road
Suite 1019
Wayne, PA 19087-1866
Ph: 610-971-4850
E-mail: info@viscma.com
Internet: http://www.viscma.com

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

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SECTION 01 42 15

METRIC MEASUREMENTS
02/14

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM SI10	(2016) American National Standard for Use of the International System of Units (SI): The Modern Metric System

1.2 GENERAL

This project includes metric units of measurements. The metric units used are the International System of Units (SI) developed and maintained by the General Conference on Weights and Measures (CGPM); the name International System of Units and the international abbreviation SI were adopted by the 11th CGPM in 1960. When both metric and English inch-pound (I-P) measurements are includedthe specification may contain measurements for products that are manufactured to an industry recognized rounded metric (hard metric) dimensions but are allowed to be substituted by I-P products, to indicate industry and/or Government standards, test values or other controlling factors, such as the code requirements where I-P values are needed for clarity, or to trace back to the referenced standards, test values or codes.

1.3 USE OF MEASUREMENTS IN SPECIFICATIONS

Measurements in specifications are either in SI or I-P units as indicated, except as otherwise authorized. When only SI or I-P measurements are specified for a product, procure the product in the specified units (SI or I-P) unless otherwise authorized by the Contracting Officer. The Contractor is responsible for all associated labor and materials when authorized to substitute one system of units for another and for the final assembly and performance of the specified work and/or products.

1.3.1 Hard Metric

Hard metric measurements are often used for field data such as distance from one point to another or distance above the floor. Products are considered to be hard metric when they are manufactured to metric dimensions or have an industry recognized metric designation.

1.3.2 Soft Metric

a. A soft metric measurement is a non-mathematical, industry related conversion. Soft metric measurements are used for measurements pertaining to products, test values, and other situations where the I-P units are the standard for manufacture, verification, or other

controlling factor.

b. A soft metric measurement is also indicated for products that are manufactured in industry designated metric dimensions but are required by law to allow substitute I-P products.

1.3.3 Neutral

A neutral measurement is indicated by an identifier which has no expressed relation to either an SI or an I-P value (e.g., American Wire Gage (AWG) which indicates thickness but in itself is neither SI nor I-P).

1.4 COORDINATION

Bring discrepancies, such as mismatches or product unavailability, arising from use of both metric and non-metric measurements and discrepancies between the measurements in the specifications and the measurements in the drawings to the attention of the Contracting Officer for resolution.

1.5 RELATIONSHIP TO SUBMITTALS

Submittals for Government approval or for information only covers the SI or I-P products actually being furnished for the project. Submit the required drawings and calculations in the same units used in the contract documents describing the product or requirement unless otherwise instructed or approved. Use ASTM SI10 as the basis for establishing metric measurements required to be used in submittals.

-- End of Document --

SECTION 01 45 00.00 10

QUALITY CONTROL
11/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E329	(2018) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 17025	(2017) General Requirements for the Competence of Testing and Calibration Laboratories

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program. Include all associated costs in the applicable Bid Schedule item.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Quality Control (CQC) Plan; G R

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system that complies with FAR Clause 52.246-12 titled "Inspection of Construction." QC consist of plans, procedures, and organization necessary to produce an end product which complies with the Contract requirements. The QC system covers all construction operations, both onsite and offsite, and be keyed

to the proposed construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the Contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project manager. The project superintendent maintains a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

3.2 CONTRACTOR QUALITY CONTROL (CQC) PLAN

Submit no later than 45 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The Government will consider an interim plan for the first 90 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work. 'Construction can only begin after the acceptance of an approved Accident Prevention Plan (Section 01 35 26, paragraph 1.7) and an approved baseline schedule (Section 01 32 17.12 10, paragraph 1.7).

3.2.1 Content of the CQC Plan

Include, as a minimum, the following to cover all construction-operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager that reports to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Furnish copies of these letters to the Contracting Officer.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures must be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer are required to be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and is identified by different trades or disciplines, or it is work by the same trade in a different environment. Although each section of the specifications can generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in the Contractor Quality Control(CQC) Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer and discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 30 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and the Contracting Officer and will become a part of the contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a Safety and Health Manager, CQC System Manager and sufficient number of additional qualified personnel to ensure safety and Contract compliance. The Safety and Health Manager reports directly to a senior project (or corporate) official independent from the CQC System Manager. The Safety and Health Manager will also serve as a member of the CQC Staff Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff maintains a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization is responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC System Manager is required to be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 10 years construction experience. This CQC System Manager is on the site at all times during construction and is employed by the prime Contractor. The CQC System Manager is assigned no other duties. Identify in the plan an alternate to serve in the event of the CQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: electrical, mechanical, civil, structural, architectural, geotechnical, and fire protection. These individuals are employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on the specialized peronnel's areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals have no other duties other than quality control.

Experience Matrix	
Area	Qualifications
Civil	Licensed Graduate Civil Engineer with 10 yrs experience in industrial projects experience
Mechanical	Graduate Mechanical Engineer with 10 yrs experience in industrial projects with special emphasis on HVAC and chiller systems construction experience
Electrical	Graduate Electrical Engineer with 10 years related experience in industrial projects, knowledge of NEC and local codes
Structural	Licensed Graduate Structural Engineer with 10 yrs experience in industrial projects
Architectural	Graduate Architect with 5 years related experience in commercial building projects experience
Geotechnical	Has minimum 10 years experience in geotechnical engineering, registered professional engineer or equivalent, and has a minimum 5 years experience in bored cast-in-place pile construction. This person shall have over five (5) years of experience in earthwork construction activities similar to that of this project.
Fire Protection	Registered professional engineer (PE) licensed to practice fire protection engineering thru National Council of Examiners for Engineering and Surveys (NCEES) examination with experience in the type of work being performed on this project
Concrete, Pavements and Soils	Materials Technician with 2 years experience for the appropriate area

Experience Matrix	
Area	Qualifications
Testing, Adjusting and Balancing (TAB) Personnel	Specialist must be a member of AABC or an experienced technician of the firm certified by the NEBB

3.4.4 Additional Requirement

In addition to the above experience and education requirements, the Contractor Quality Control(CQC) System Manager and Alternate CQC System Manager are required to have completed the Construction Quality Management (CQM) for Contractors course. If the CQC System Manager does not have a current certification, obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the Contracting Officer for information on the next scheduled class.

The Construction Quality Management Training certificate expires after 5 years. If the CQC System Manager's certificate has expired, retake the course to remain current.

3.4.5 Organizational Changes

Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.4.6 Commissioning Authority

3.4.6.1 Commissioning Authority Qualifications

The Commissioning Authority shall be a member of the QC organization, shall coordinate actions with the QC Manager, shall not be subordinate to the Project Superintendent or the Project Manager, and shall report findings directly to the Government. The Commissioning Authority may also act as the DQC Manager if all DQC Manager qualifications are met. The Commissioning Authority selected shall have the following qualifications:

a. Be certified by a recognized Building Commissioning Organization. Acceptable minimum certifications are "Certified Cx Agent" from the Associated Air Balance Council (AABC); "Certified Building Cx Professional" from the Association of Energy Engineers (AEE); "Certified Cx Professional (CxP)" from the Building Commissioning Association (BCA); "Commissioning Process Authority Professional" or "Commissioning Process Manager" from the University of Wisconsin College of Engineering; a NEBB qualified Systems Commissioning Administrator (SCA); or ICB/TABB Certified Commissioning Supervisor.

b. Have documented five years of Commissioning experience, including two projects of similar size and complexity. Provide proof of commissioning experience as part of the Commissioning Plan.

3.4.6.2 Commissioning Authority Responsibilities

a. Be responsible for development of the Commissioning Plan, the Summary Commissioning Report, and minutes of all commissioning meetings.

b. Review the Request for Proposal (RFP) for energy and sustainability goals, system expectations, O&M requirements, training expectations, and construction quality expectations.

c. Ensure commissioning requirements are incorporated into the construction documents.

d. Be responsible for implementation and updating of the Commissioning Plan.

e. Be responsible for development of systems functional testing procedures.

f. Ensure pre-functional installation inspections are performed on all systems indicated to be commissioned in accordance with the Commissioning Plan and Contract documents.

g. Verify systems performance of all systems indicated to be commissioned in accordance with the Commissioning Plan and Contract documents.

h. Report any deficiencies in installation or performance of all systems indicated to be commissioned.

i. Coordinate all training issues and validate that the testing and training requirements of this contract are accomplished.

3.5 SUBMITTALS AND DELIVERABLES

Submittalswill comply with the requirements in Section 01 33 00SUBMITTAL PROCEDURES. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

CQC is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control are required to be conducted by the CQC System Manager for each definable feature of the construction work as follows:

3.6.1 Preparatory Phase

This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes:

a. A review of each paragraph of applicable specifications, reference codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government

personnel until final acceptance of the work.

b. Review of the Contract drawings.

c. Check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract.

f. Examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. Review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government needs to be notified at least 24 hours in advance of beginning the preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase is accomplished at the beginning of a definable feature of work. Accomplish the following:

a. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing are in compliance with the contract.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with

each worker.

f. The Government needs to be notified at least 24 hours in advance of beginning the initial phase for definable feature of work. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with follow-up phases.

g. The initial phase for each definable feature of work is repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. Procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual

test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

3.7.2 Testing Laboratories

The testing laboratory must be accredited by an independent third party accrediting agency to ISO 17025 or ASTM E329 or validated by USACE. The listing of validated testing laboratories in the Middle East region is located at the following website:

http://www.tam.usace.army.mil/Business-With-Us/

Expand "Engineering and Design" and click the link for "TAM Validated Labs Register

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel is required to meet criteria detailed in ISO 17025, ASTM D3740, and ASTM E329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $6,000 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Conduct an inspection of the work by the CQC System Manager near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS FAR Clause 52.211-10, "Commencement, Prosecution, and Completion of Work", or by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications, as required by paragraph DOCUMENTATION. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. These inspections and any deficiency corrections required by this paragraph need to be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative is required to be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands can also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notify the Contracting Officer at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the Contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

3.9.1 Quality Control Activities

Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:

a. The name and area of responsibility of the Contractor/Subcontractor.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the control phase (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

3.9.2 Verification Statement

Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. Furnish the original and one copy of these records in report form to the Government daily within 36 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, prepare and submit one report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the Contractor Quality Control(CQC) System Manager. Include copies of test reports and copies of reports prepared by all subordinate quality control personnel within the CQC System Manager Report.

3.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer can issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

SECTION 01 45 00.15 10

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)
11/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 MEASUREMENT AND PAYMENT

The work of this section is not measured for payment. The Contractor is responsible for the work of this section, without any direct compensation other than the payment received for contract items.

1.3 CONTRACT ADMINISTRATION

The Government will use the Resident Management System (RMS) to assist in its monitoring and administration of this contract. The Government accesses the system using the Government Mode of RMS (RMS GM) and the Contractor accesses the system using the Contractor Mode (RMS CM). The term RMS will be used in the remainder of this section for both RMS GM and RMS CM. The joint Government-Contractor use of RMS facilitates electronic exchange of information and overall management of the contract. The Contractor accesses RMS to record, maintain, input, track, and electronically share information with the Government throughout the contract period in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Closeout
Import/Export of Data

1.3.1 Correspondence and Electronic Communications

For ease and speed of communications, exchange correspondence and other documents in electronic format to the maximum extent feasible. Some correspondence, including pay requests and payrolls, are also to be provided in paper format with original signatures. Paper documents will govern, in the event of discrepancy with the electronic version.

1.3.2 Other Factors

Other portions of this document have a direct relationship to the reporting accomplished through RMS. Particular attention is directed to

FAR 52.236-15 Schedules for Construction Contracts; FAR 52.232-27 Prompt Payment for Construction Contracts; FAR 52.232-5 Payments Under Fixed-Priced Construction Contracts; Section 01 32 17.12 10 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS); Section 01 33 00 SUBMITTAL PROCEDURES; Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS; and Section 01 45 00.00 10 QUALITY CONTROL.

1.4 RMS SOFTWARE

RMS is a web based application. Download, install and be able to utilize the latest version of RMS within 7 calendar days of receipt of the Notice to Proceed. RMS software, user manuals, access and installation instructions, program updates and training information are available from the RMS website (https://rms.usace.army.mil). The Government and the Contractor will have different access authorities to the same contract database through RMS. The common database will be updated automatically each time a user finalizes an entry or change.

1.5 CONTRACT DATABASE - GOVERNMENT

The Government will enter the basic contract award data in RMS prior to granting the Contractor access. The Government entries into RMS will generally be related to submittal reviews, correspondence status, and Quality Assurance(QA)comments, as well as other miscellaneous administrative information.

1.6 CONTRACT DATABASE - CONTRACTOR

Contractor entries into RMS establish, maintain, and update data throughout the duration of the contract. Contractor entries generally include prime and subcontractor information, daily reports, submittals, RFI's, schedule updates and payment requests. RMS includes the ability to import attachments and export reports in many of the modules, including submittals. The Contractor responsibilities for entries in RMS typically include the following items:

1.6.1 Administration

1.6.1.1 Contractor Information

Enter all current Contractor administrative data and information into RMS within 7 calendar days of receiving access to the contract in RMS. This includes, but is not limited to, Contractor's name, address, telephone numbers, management staff, and other required items.

1.6.1.2 Subcontractor Information

Enter all missing subcontractor administrative data and information into RMS CM within 7 calendar days of receiving access to the contract in RMS or within 7 calendar days of the signing of the subcontractor agreement for agreements signed at a later date. This includes name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor is listed separately for each trade to be performed.

1.6.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office

with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters are numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C" or "RFP".

1.6.1.4 Equipment

Enter and maintain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 Reports

Track the status of the project utilizing the reports available in RMS. The value of these reports is reflective of the quality of the data input. These reports include the Progress Payment Request worksheet, Quality Control (QC) comments, Submittal Register Status, and Three-Phase Control worksheets.

1.6.1.6 Request For Information (RFI)

Create and track all Requests For Information (RFI) in the RMS Administration Module for Government review and response.

1.6.2 Finances

1.6.2.1 Pay Activity Data

Develop and enter a list of pay activities in conjunction with the project schedule. The sum of pay activities equals the total contract amount, including modifications. Each pay activity must be assigned to a Contract Line Item Number (CLIN). The sum of the activities assigned to a CLIN equals the amount of each CLIN.

1.6.2.2 Payment Requests

Prepare all progress payment requests using RMS. Update the work completed under the contract at least monthly, measured as percent or as specific quantities. After the update, generate a payment request and prompt payment certification using RMS. Submit the signed prompt payment certification and payment request as well as supporting data either electronically or by hard copy. Unless waived by the Contracting Officer, a signed paper copy of the approved payment certification and request is also required and will govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

Enter and track implementation of the 3-phase QC Control System, QC testing, transferred and installed property and warranties in RMS. Prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements in RMS. Maintain all data on a daily basis. Insure that RMS reflects all quality control methods, tests and actions contained within the Contractor Quality Control (CQC) Plan and Government review comments of same within 7 calendar days of Government acceptance of the CQC Plan.

1.6.3.1 Quality Control (QC) Reports

The Contractor's Quality Control (QC) Daily Report in RMS is the official report. The Contractor can use other supplemental formats to record QC data, but information from any supplemental formats are to be consolidated and entered into the RMS QC Daily Report. Any supplemental information may be entered into RMS as an attachment to the report. QC Daily Reports must be finalized and signed in RMS within 24 hours after the date covered by the report. Provide the Government a printed signed copy of the QC Daily Report, unless waived by the Contracting Officer.

1.6.3.2 Deficiency Tracking.

Use the QC Daily Report Module to enter and track deficiencies. Deficiencies identified and entered into RMS by the Contractor or the Government will be sequentially numbered with a QC or QA prefix for tracking purposes. Enter each deficiency into RMS the same day that the deficiency is identified. Monitor, track and resolve all QC and QA entered deficiencies. A deficiency is not considered to be corrected until the Government indicates concurrence in RMS.

1.6.3.3 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in RMS. Worksheets for the three-phase control meetings are generated within RMS.

1.6.3.4 Labor and Equipment Hours

Enter labor and equipment exposure hours on a daily basis. Roll up the labor and equipment exposure data into a monthly exposure report.

1.6.3.5 Accident/Safety Reporting

Both the Contractor and the Government enter safety related comments in RMS as a deficiency. The Contractor must monitor, track and show resolution for safety issues in the QC Daily Report area of the RMS QC Module. In addition, follow all reporting requirements for accidents and incidents as required in EM 385-1-1, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and as required by any other applicable Federal, State or local agencies.

1.6.3.6 Definable Features of Work

Enter each feature of work, as defined in the approved CQC Plan, into the RMS QC Module. A feature of work may be associated with a single or multiple pay activities, however a pay activity is only to be linked to a single feature of work.

1.6.3.7 Activity Hazard Analysis

Import activity hazard analysis electronic document files into the RMS QC Module utilizing the document package manager.

1.6.4 Submittal Management

Enter all current submittal register data and information into RMS within 7 calendar days of receiving access to the contract in RMS. The information shown on the submittal register following the specification

Section 01 33 00 SUBMITTAL PROCEDURES will already be entered into the RMS database when access is granted. Group electronic submittal documents into transmittal packages to send to the Government, except very large electronic files, samples, spare parts, mock ups, color boards, or where hard copies are specifically required. Track transmittals and update the submittal register in RMS on a daily basis throughout the duration of the contract. Submit hard copies of all submittals unless waived by the Contracting Officer.

1.6.5 Schedule

Enter and update the contract project schedule in RMS by either manually entering all schedule data or by importing the Standard Data Exchange Format (SDEF) file, based on the requirements in Section 01 32 17.12 10 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS).

1.6.6 Closeout

Closeout documents, processes and forms are managed and tracked in RMS by both the Contractor and the Government. Ensure that all closeout documents are entered, completed and documented within RMS.

1.7 IMPLEMENTATION

Use of RMS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain contract data within the RMS system. RMS is an integral part of the Contractor's required management of quality control.

1.8 NOTIFICATION OF NONCOMPLIANCE

Take corrective action within 7 calendar days after receipt of notice of RMS non-compliance by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
08/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	(continuously updated) List of Approved Backflow Prevention Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2013; Errata 2015) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES: :

SD-01 Preconstruction Submittals

Construction site plan; G M/R

SD-03 Product Data

Backflow preventers

SD-06 Test Reports

Backflow Preventer Tests; G M

SD-07 Certificates

Backflow Tester Certification

Backflow Preventers Certificate of Full Approval

1.3 CONSTRUCTION SITE PLAN

After NSA Bahrain PWD identifies an approved area for the laydown/mobilization area and prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.4 AREA USE PLAN

The Contractor shall submit to the Contracting Officer, within twenty (20) calendar days after Notice to Proceed, an Area Use Plan designating intended use of all areas within the project boundaries. The project boundaries includes the area within the limits of construction as noted on the drawings and the contractor mobilization area provided. This plan shall include, but not necessarily be limited to the following: the proposed location and dimensions of any area to be fenced and used by the Contractor; construction plant and building installations/the number of trailers and facilities to be used; avenues of ingress/egress to the fenced areas and details of the fence installation; drawings showing temporary electrical installations; temporary water and sewage disposal installations; material storage areas; hazardous storage areas. Any areas which may have to be graveled shall also be identified. The plan shall also include a narrative description of the building structural system, the site utility system; and the office or administration facilities. The Contractor shall also indicate if the use of a supplemental staging area or off-base mobilization area is desired. The Contractor shall not begin construction of the mobilization facilities prior to approval by the Contracting Officer of the Area Use Plan described herein.

1.5 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.5.1 Backflow Tester Certificate

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester

has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with any company participating in any other phase of this Contract.

1.5.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 915 by 1220 mm in size for displaying weekly project status, progress photos, safety information, and other information approved by the Contracting Officer.

2.1.2 Project and Safety Signs

The requirements for the signs, their content, and location are as specified in Section 01 58 00 PROJECT IDENTIFICATION. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Haul Roads

Construct access and haul roads necessary for proper prosecution of the work under this contract. Construct with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic are be avoided. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations.

2.2.2 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.3 Fencing

Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people.

a. The safety fencing must be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 1.1 m high, supported and tightly secured to steel posts located on maximum 3 m centers, constructed at the approved location. Install fencing to be able to restrain a force of at least 114.00 kg against it.

b. In addition, prior to the start of work, enclose the construction site and mobilization areas which are not within the construction fence with a temporary safety fence, including gates and warning signs, to protect the public from construction activities. The safety fence shall be made of chain link, a minimum of 1100 mm high, supported and tightly secured to steel posts located on minimum 3000 mm centers. Remove the fence from the work site upon completion of the contract.

2.2.4 Temporary Wiring

Provide temporary wiring in accordance with EM 385-1-1, section 11.E, NFPA 241 and NFPA 70. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Employee parking is not available on project site. All employee parking will be off base.

3.2 TEMPORARY BULLETIN BOARD

Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.

3.3 AVAILABILITY AND USE OF UTILITY SERVICES

3.3.1 Temporary Utilities

Contractor shall make their own arrangements for temporary utilities. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards. Contractor shall reimburse the utility department for utility usage. The Contractor shall make all temporary utilities connections required at their own expense.

3.3.2 Sanitation

a. Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and / or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

b. Provide temporary sewer and sanitation facilities that are self-contained units with both urinals and stool capabilities. Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the Contracting Officer. The doors shall be self-closing. The exterior of the unit shall match the base standard color. Locate the facility behind the construction fence or out of the public view.

3.3.3 Telephone

Make arrangements and pay all costs for telephone facilities desired.

3.3.4 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 30 meter above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer.

3.3.5 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.4 TRAFFIC PROVISIONS

3.4.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on roadways except with written permission of the Contracting Officer at least 30 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with local regulations. Make all notifications and obtain any permits required for modification to traffic movements. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the local authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

3.4.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as

required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.4.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations without notification to and approval by the Contracting Officer.

3.4.4 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.5 CONTRACTOR'S MOBILIZATION AREA

The Contractor will be permitted to use designated area within Isa Air Base as directed by the Contracting Officer for operation of his construction equipment and plants, shops, warehouses, and offices. The Contractor shall not be authorized to have living accommodations for his work force on the site. The Contractor is responsible for obtaining any required additional mobilization area above that designated. On completion of the contract, all facilities shall be removed from the mobilization area by the Contractor and shall be disposed of in accordance with applicable Host Government Laws and Regulations. The site shall be cleared of construction debris and other materials and the area restored to its final grade.

3.5.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.5.2 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

3.5.3 Storage Area

Construct a temporary 1.8 m high chain link fence around trailers and materials. Include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store Trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception

of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.5.4 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer may designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site. Contractor shall plan for their own additional storage areas as required. Fencing of materials or equipment will not be required at this site; however, the Contractor is responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

3.5.5 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on installation property.

b. Paint using suitable paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.5.6 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

3.5.7 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office. In addition, the Contractor shall comply with any additional requirements specified in the Construction Security Plan (CSP).

3.5.8 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building

from damage.

3.5.8.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

3.6 CONTRACTOR'S OFF BASE MOBILIZATION AREA

If the Contractor requires an additional area for his operations to support this contract in excess of that shown in the RFP (see Supplemental Storage Area), the Contractor shall provide, furnish, operate and maintain facilities for his operations in an area off base. The Contractor must submit his desired site location to the Contracting Officer for approval. All utilities will be the responsibility of the Contractor and shall be provided at no cost to the Government. On completion of the contract, all facilities shall be removed by the Contractor and shall be disposed of in the manner directed by the Contracting Officer. The site shall be cleared of construction debris and other materials and the area restored to its original condition.

3.6.1 Facilities Within the Mobilization Site

All facilities within the Contractor's mobilization site shall be of substantial construction suitable for the local weather conditions. Messing and sanitary facilities shall meet the requirements of Corps of Engineers Safety and Health Requirements Manual EM 385-1-1. The Contractor shall provide all utilities required to make the site self-sufficient.

3.6.2 Special Requirements

The Contractor shall be responsible for coordinating with the Host Government use of any existing roads as haul routes. Construction, and routing of new haul roads, and/or upgrading of existing roads for the Contractor's use, is the sole responsibility of the Contractor. It shall be the Contractor's responsibility to obtain such local authorizations, permits and licenses necessary to establish his mobilization camp, quarry operations, batching operations and haul routes.

3.7 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor must install a satisfactory means of communication, such as telephone or other suitable devices and made available for use by Government personnel.

3.8 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project

safety fencing at the work site. Fencing shall be 1.8 m high chain link and include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.9 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store any salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

3.10 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore areas used by the Contractor for the storage of equipment or material, or other use to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

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SECTION 01 57 19.12 10

TEMPORARY ENVIRONMENTAL CONTROLS
12/18

PART 1 GENERAL

1.1 BAHRAIN STANDARDS

KINGDOM OF BAHRAIN FINAL GOVERNING STANDARDS (FGS) 13 MARCH 2012 (Exhibit A)

Chapter 1 Overview

Chapter 2 Air Emissions

Chapter 3 Drinking Water

Chapter 4 Wastewater

Chapter 5 Hazardous Materials

Chapter 6 Hazardous Waste

Chapter 7 Solid Waste

Chapter 8 Medical Waste Management

Chapter 9 Petroleum, Oil and Lubricants

Chapter 10 Pesticides

Chapter 11 Historic and Cultural Resources

Chapter 12 Natural Resources and Endangered Species

Chapter 13 Polychlorinated Biphenyls

Chapter 14 Asbestos

Chapter 15 Lead-Based Paint

Chapter 16 Spill Prevention and Response Planning

Chapter 17 Underground Storage Tanks

Appendix AP1 Appendix 1 - Characteristics of Hazardous Waste and Lists of Hazardous Waste and Hazardous Materials

Appendix AP2 Appendix 2 - Determination of Worst Case Discharge Planning Volume

1.2 DEFINITIONS

1.2.1 Class I and II Ozone Depleting Substance (ODS)

ODS are listed in Chapter 2, Tables 2.2 and 2.3 of the FGS.

1.2.2 Contractor Generated Hazardous Waste

A discarded material that may be solid, semi-solid, liquid, or contained gas, and either exhibit a characteristic of a hazardous waste as defined in section Appendix1.1.or is listed as a hazardous waste in Tables Appendix 1, Tables T1. Through T4. Excluded from this definition are domestic sewage sludge, and household and medical wastes not possessing the properties in Chapter 6, Table 6.1 of the FGS. It includes the following:

a. Discarded materials that contain one or more of the characteristics or properties described in Tables 6.1 or 6.2.

b. All hazardous waste described in Tables 6.3 through 6.8.

c. Any other form of waste defined as hazardous by the Competent Authority.

These waste streams typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e., methyl ethyl ketone, toluene), waste thinners, excess paints, excess solvents, waste solvents, excess pesticides, and contaminated pesticide equipment waste water.

1.2.3 Cultural Resources

Physical remains of any prehistoric or historic district, site, building, structure, or object significant in world, national or local history, architecture, archeology, engineering, or culture. The term includes artifacts, archeological resources, records, and material remains that are related to such a district, site, building, structure, or object, and also includes natural resources (plants, animals, landscape features, etc.) that may be considered important as a part of a country's traditional culture and history. The term also includes any property listed on the World Heritage List or the Bahraini equivalent of the National Register of Historic Places. Bahraini lists of properties should be evaluated to determine if they are equivalent with the National Register of Historic Places prior to application.

1.2.4 Electronic Waste

Electronic waste is discarded electronic devices intended for salvage, recycling, or disposal.

1.2.5 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally or historically.

1.2.6 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.7 Hazardous Debris

As defined in paragraph SOLID WASTE, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) in accordance with FGS Chapter 6. Hazardous debris also includes debris that exhibits a characteristic of hazardous waste in accordance with FGS Chapter 6.

1.2.8 Hazardous Materials

Hazardous materials are any material that is capable of posing an unreasonable risk to health, safety, or the environment if improperly handled, stored, issued, transported, labeled, or disposed because it displays a characteristic listed in FGS Chapter 5, Table 5.1., Typical Hazardous Materials Characteristics, or the material is listed in FGS Table Appendix 1.4., List of Hazardous Waste/Substances/Materials. Munitions are excluded.

1.2.9 Hazardous Waste

Hazardous Waste is any material that meets the definition of a solid waste and exhibits a hazardous characteristic (ignitability, corrosivity, reactivity, or toxicity) as specified in the FGS, Chapter 6. Hazardous waste is discarded material that may be solid, semi-solid, liquid, or contained gas, and either exhibits a characteristic of a hazardous waste as defined in FGS Appendix 1.1 or is listed as a hazardous waste in Tables Appendix 1, Tables T1. Through T4. Excluded from this definition are domestic sewage sludge, and household and medical wastes not possessing the properties in Chapter 6, Table 6.1 of the FGS. It includes the following:

a. Discarded materials that contain one or more of the characteristics or properties described in Tables 6.1 or 6.2.

b. All hazardous waste described in Tables 6.3 through 6.8.

c. Any other form of waste defined as hazardous by the Competent Authority.

1.2.10 Installation Pest Management Coordinator

Installation Pest Management Coordinator (IPMC) is the individual officially designated by the Installation Commander to oversee the Installation Pest Management Program and the Installation Pest Management Plan.

1.2.11 Land Application

Land Application means spreading or spraying discharge water at a rate

that allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the Waters of the Host Nation must occur. Comply with the FGS.

1.2.12 Oily Waste

Oily waste are those materials that are, or were, mixed with Petroleum, Oils, and Lubricants (POLs) and have become separated from that POLs. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residues or sludges, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, POLs and may be appropriately tested and discarded in a manner which is in compliance with Chapter 6 of the FGS. This definition includes materials such as oily rags, "kitty litter" sorbent clay and organic sorbent material. Oily waste with a high percentage of water (as determined following laboratory analysis) is to be disposed via a licensed hauling transporter at Bahrain Petroleum Company (BAPCO). An original manifest from the Kingdom of Bahrain's Supreme Council for Environment (SCE) is to be prepared, signed by the licensed transporter, and submitted with the laboratory reports for pH and percent of oil/water content to the SCE for approval. Oily waste with a high percentage of oil (85% or greater) can be turned into the Environmental Department for recycling. Centrifuge solids, filter residues or sludge, bottom sediments, tank bottoms, oily rags, kitty litter, sorbents, etc. are to be containerized ad turned into the Environmental Department for proper disposal via DLA.

1.2.13 Pesticide

Pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.14 Pesticide Treatment Plan

A plan for the prevention, monitoring, and control to eliminate pest infestation.

1.2.15 Pests

Pests are arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.16 Project Pesticide Coordinator

The Project Pesticide Coordinator (PPC) is an individual who resides at a Civil Works Project office and who is responsible overseeing of pesticide application on project grounds.

1.2.17 Regulated Waste

Regulated waste are solid wastes that have specific additional Host Nation controls for handling, storage, or disposal.

1.2.18 Sediment

Sediment is soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.19 Solid Waste

Solid waste is garbage, refuse, sludge, and other discarded materials, including solid, semi-solid, liquid, and contained gaseous materials resulting from industrial and commercial operations and from community activities. It does not include solids or dissolved material in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluent, dissolved materials in irrigation return flows, or other common water pollutants.

Types of solid waste typically generated at construction sites may include:

1.2.19.1 Debris

Debris is non-hazardous solid material generated during the construction, demolition, or renovation of a structure that exceeds 60 mm (2.5-inch) particle size that is: a manufactured object; plant or animal matter; or natural geologic material (for example, cobbles and boulders), broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may not be reinforced with or contain ferrous wire, rods, accessories and weldments. A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

1.2.19.2 Green Waste

Green waste is the vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

1.2.19.3 Bulky Waste

Large items of solid waste such as household appliances, furniture, large auto parts, trees, branches, stumps, and other oversize wastes whose large size precludes or complicates their handling by normal solid wastes collection, processing, or disposal methods.

1.2.20 Material Not Regulated As Solid Waste

Material not regulated as solid waste is nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

1.2.21 Non-Hazardous Waste

Non-hazardous waste is waste that is excluded from, or does not meet, hazardous waste criteria in accordance with Chapter 6 of the FGS.

1.2.22 Recyclables

Recyclables are materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable,wiring,insulated/non-insulated copper wire cable,wire rope, and structural components. It also includes commercial-grade refrigeration equipment with Freon removed, household appliances where the basic material content is metal, clean polyethylene terephthalate bottles, cooking oil, used fuel oil, textiles, high-grade paper products and corrugated cardboard, stackable pallets in good condition, clean crating material, and clean rubber/vehicle tires. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans that meet the definition of empty containers in accordance with may be included as recyclable if sold to a scrap metal company.

1.2.23 Reportable Release

A reportable release means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a known or unknown material or hazardous substance that poses an immediate threat to human health or the environment to the air, soil, or water.

Report all spills to Environmental. Refer section 3.7.4 Releases/Spills of Oil and Hazardous Substances.

1.2.24 Scrap Metal

This includes scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe, and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

1.2.25 Spill Event

A spill is any release of oil or hazardous substances to the water or ground that is not controlled or permitted. This includes any spilling, leaking, pumping, emitting, discharging, injecting, escaping, leaching, disposing, or dumping of liquid or solid material that is not authorized in writing by the Contracting Officer.

1.2.26 Surplus Soil

Surplus soil is existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars, and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included and must be managed in accordance with paragraph HAZARDOUS MATERIAL MANAGEMENT.

1.2.27 Surface Discharge

Surface discharge means discharge of water into drainage ditches, storm sewers, creeks or other surface water bodies. Surface discharges are discrete, identifiable sources and may require a permit from the Host Nation. Comply with Chapter 4 of the FGS.

1.2.28 Stormwater

Stormwater is any precipitation in an urban or suburban area that does not evaporate or soak into the ground, but instead collects and flows into storm drains, rivers, and streams.

1.2.29 Universal Waste

Universal wastes are certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (for example, thermostats), and lamps (for example, fluorescent bulbs). These wastes are collected and sent for recycling or proper disposal.

1.2.30 Wastewater

Wastewater is the used water and solids from a community that flow to a treatment plant. Wastewater is also any water which during manufacturing or processing, comes into direct contact with, or results from the production or use of, any raw material, intermediate product, finished product, by-product, or waste product.

1.2.31 Waters of the Host Nation

Surface water including the territorial seas recognized under customary international law, including:

a. All waters which are currently used, were used in the past, or may be susceptible to use in commerce.

b. Waters which are or could be used for recreation or other purposes.

c. Waters from which fish or shellfish are or could be taken and sold.

d. Waters which are used or could be used for industrial purposes by industries.

e. Waters including lakes, rivers, streams (including intermitten streams), sloughs, prairie potholes, or natural ponds.

f. Tributaries of waters identified in this definition.

1.2.32 Wetlands

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

1.2.33 Wood

Wood is dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included. Treated wood includes, but is not limited to, lumber, utility poles, crossties, and other wood products with chemical treatment.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preconstruction Survey

Regulatory Notifications; G R

Environmental Protection Plan; G R

Employee Training Records; G R

SD-06 Test Reports

Laboratory Analysis

Inspection Reports

Solid Waste Management Report; G R

SD-07 Certificates

Employee Training Records; G R

HAZWOPER Certificate Of Completion; G R

SD-11 Closeout Submittals

Stormwater Pollution Prevention Plan Compliance Notebook; G R

Waste Determination Documentation; G R

Disposal Documentation for Hazardous and Regulated Waste; G R

Assembled Employee Training Records; G R

Solid Waste Management Report; G R

Contractor Hazardous Material Inventory Log; G R

Hazardous Waste/Debris Management; G R

Regulatory Notifications; G R

Sales Documentation; G R

Contractor Certification

As-Built Topographic Survey

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined and described in the EPP. Plan for and provide environmental protective measures to control pollution that develops during construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Protect the environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire duration of this Contract. Comply with the FGS pertaining to the environment, including water, air, solid waste, hazardous waste and substances, and oily substances.

Tests and procedures assessing whether construction operations comply with applicable environmental laws may be required. Analytical work must be performed by qualified laboratories; and where required by law, the laboratories must be certified.

1.4.1 Training in Hazardous Waste Operations and Emergency Response (HAZWOPER)

1.4.1.1 Personnel Requirements

Appoint in writing to the Isa Air Base Environmental Department the Environmental Coordinators (ECs) (Primary and an Alternate) for the project site. The blank designation form will be available at the Isa Air Base Environmental Department office. The ECs and construction workers must complete applicable HAZWOPER training modules (installation specific or general) prior to starting respective portions of on-site work under this Contract. If personnel changes occur for any of these positions after starting work, replacement personnel must complete applicable HAZWOPER training within 14 days of assignment to the project.

All personnel assigned to handling Hazardous Waste and Hazardous Materials are properly trained to meet, at a minimum, OSHA standards, 29 CFR 1910.120 Contractor shall assign properly trained Environmental coordinators to ensure proper management of HAZMATs and HW, and to properly respond to oil and hazardous substance (OHS) spills. Contractor assigned ENV coordinators must have at least successfully completed the 24-hr Hazardous Waste Management and Emergency response (HAZWOPER) or its equivalent. Prepare and Maintain employee training records throughout the term of the contract.

1.4.1.2 Certification

Below requirements for HAZWOPER Certification Training shall be coordinated and as directed by the Contracting Officer.

Submit an OSHA 24 hour HAZWOPER certificate of completion for personnel who have completed the required HAZWOPER training. An 8-hour refresher training course is available if previously certified for the 24-hour course. This training is web-based and can be accessed from any computer with Internet access at the below link:

https://oshaeducationcenter.com

Above courses may be available at NSA Bahrain.

Refrigerant technicians shall be trained in proper recovery/recycling

procedures, leak detection, safety, shipping, and disposal in accordance with recognized industry standards or Bahraini equivalent.

1.4.1.3 Refresher Training

This training has been structured to allow contractor personnel to receive credit under this contract and to carry forward credit to future contracts. Ensure the Environmental Manager review their training plans for new modules or updated training requirements prior to beginning work. Some training modules are tailored for specific state regulatory requirements; therefore, Contractors working in multiple states will be required to retake modules tailored to the state where the contract work is being performed.

1.4.2 Conformance with the Environmental Management System

Perform work under this contract consistent with the policy and objectives identified in the installation's Environmental Management System (EMS). Perform work in a manner that conforms to objectives and targets of the environmental programs and operational controls identified by the EMS. Support Government personnel when environmental compliance and EMS audits are conducted by escorting auditors at the Project site, answering questions, and providing proof of records being maintained. Provide monitoring and measurement information as necessary to address environmental performance relative to environmental, energy, and transportation management goals. In the event an EMS nonconformance or environmental noncompliance associated with the contracted services, tasks, or actions occurs, take corrective and preventative actions. In addition, employees must be aware of their roles and responsibilities under the installation EMS and of how these EMS roles and responsibilities affect work performed under the contract.

Coordinate with the installation's EMS manager to identify training needs associated with environmental aspects and the EMS, and arrange training or take other action to meet these needs. Provide training documentation to the Contracting Officer. The Installation Environmental Department will retain associated environmental compliance records. Make EMS Awareness training completion certificates available to Government auditors during EMS audits and include the certificates in the Employee Training Records. See paragraph EMPLOYEE TRAINING RECORDS.

1.5 QUALITY ASSURANCE

1.5.1 Preconstruction Survey and Protection of Features

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, perform a Preconstruction Survey of the project site with the Contracting Officer, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record. Include in the report a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. The Contractor and the Contracting Officer will sign this survey report upon mutual agreement regarding its accuracy and completeness. Protect those environmental features included in the survey

report and any indicated on the drawings, regardless of interference that their preservation may cause to the work under the Contract.

1.5.2 Regulatory Notifications

Provide regulatory notification requirements in accordance with and Host Nation regulations. Typically, regulatory notifications must be provided for the following (this listing is not all-inclusive): demolition, renovation, construction, removal or use of an air emissions sources, and remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.5.3 Environmental Brief

Attend an environmental brief to be included in the preconstruction meeting. Provide the following: types, quantities, use of hazardous materials and copy of Safety Data Sheet (SDS) that will be brought onto the installation for Environmental review and approval; and types and quantities of solid wastes/Hazwaste/wastewater that may be generated during the Contract. Discuss the results of the Preconstruction Survey at this time.

Prior to initiating any work on site, meet with the Contracting Officer and installation Environmental Department to discuss the proposed EPP. Develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural and cultural resources, required reports, required permits, permit requirements (such as mitigation measures), and other measures to be taken.

1.5.4 Environmental Coordinator

The designated EC will be directly responsible for coordinating contractor compliance with DoD, Navy and Host nation requirements. This can be a collateral position; however the person in this position must be trained to adequately accomplish the duties and responsibilities specified in Isa Air Base EC form. ECs are required to appear for a face-to-face interaction with the Isa Air Base Environmental EMS program coordinator to understand the policies, regulations and compliance requirement. The ECs are directly responsible for coordinating contractor compliance with federal, state, local, and installation requirements. The EC must ensure compliance with Hazardous Waste Program requirements (including hazardous waste handling, storage, manifesting, and disposal); implement the EPP; ensure environmental permits are obtained, maintained, and closed out; ensure compliance with Stormwater Program requirements; ensure compliance with Hazardous Materials (storage, handling, and reporting) requirements; and coordinate any remediation of regulated substances (lead, asbestos, PCB transformers). This can be a collateral position; however, the person in this position must be trained to adequately accomplish the following duties: ensure waste segregation and storage compatibility requirements are met; inspect and manage Satellite Accumulation areas; ensure only authorized personnel add wastes to containers; ensure Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; coordinate removal of waste containers; and maintain the Environmental Records binder and required documentation, including environmental permits compliance and close-out. Submit EC Qualifications to the Contracting Officer.

1.5.5 Employee Training Records

Prepare and maintain Employee Training Records throughout the term of the contract and maintain in the Environmental records binder. Provide Employee Training Records in the Environmental Records Binder. Ensure every employee completes a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures compliance with the FGS. Provide a Position Description for each employee, by subcontractor, based on the Davis-Bacon Wage Rate designation or other equivalent method, evaluating the employee's association with hazardous and regulated wastes. This Position Description will include training requirements for a Hazardous Waste Generator facility. Submit these Assembled Employee Training Records to the Contracting Officer at the conclusion of the project, unless otherwise directed.

Train personnel to meet FGS requirements. Conduct environmental protection/pollution control meetings for personnel prior to commencing construction activities. Conduct additional meetings for new personnel and when site conditions change. Include in the training and meeting agenda: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, waters of the Host Nation, and endangered species and their habitat that are known to be in the area.

1.5.5.1 Pest Control Training

Trained personnel in pest control. Conduct a pest control meeting for personnel prior to commencing construction activities. Conduct additional meetings for new personnel and when site conditions change. Include in the training and meeting agenda: methods of detecting and pest infestation; familiarization with statutory and contractual pest control standards; installation and care of devices, and instruments, if required, for monitoring purposes to ensure adequate and continuous pest control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of waters of the Host Nation, and endangered species and their habitat that are known to be in the area.

1.5.6 Non-Compliance Notifications

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with the FGS and other elements of the Contractor's EPP. After receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation.

1.6 LICENSES AND PERMITS

Obtain licenses and permits required for the construction of the project and in accordance with FAR 52.236-7. Notify the Government of all general use permitted equipment the Contractor plans to use on site. This

paragraph supplements the Contractor's responsibility under FAR 52.236-7.

1.7 SOLID WASTE MANAGEMENT PLAN

Provide the Contracting Officer with written notification of the quantity of anticipated solid waste or debris that is anticipated or estimated to be generated by construction. Include in the report the locations where various types of waste will be disposed of or recycled. Include letters of acceptance from the receiving location or as applicable; submit one copy of the receiving location license showing such entities approval of the disposal plan before transporting wastes off Government property.

1.7.1 Solid Waste Management Report

Monthly, submit a solid waste disposal report to the Contracting Officer. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste.

1.8 ENVIRONMENTAL PROTECTION PLAN (EPP)

The purpose of the EPP is to present an overview of known or potential environmental issues that must be considered and addressed during construction. Include objectives and targets from the installation's EMS pertaining to construction into the EPP.

A plan (including drawings and figures) to address temporary erosion and sediment control, solid and hazardous waste management, natural and cultural resources, and other environmental media as identified below. The EPP shall include the following:

Project description, general site information, and project environmental goals. Show work area plan of the proposed activity in each portion of the area and identify the areas of limited use or nonuse, including laydown areas. Include measures for marking the limits of use areas, including methods for protection of features to be preserved within authorized work areas and methods to control runoff and to contain materials on site, and a traffic control plan.

Environmental and Historical/Archaeological Resource Permits and Authorizations Required, Including Regulatory Notification. Certification of Environmental and Cultural Permits Obtained by Contractor or HN Installation Commander.

Sensitive/protected natural and cultural resources on the project site(s) and preconstruction survey results.

Protection measures for the following environmental media (as applicable to the project):

- Natural resource protection including vegetation and wildlife protection and revegetation (including threatened and endangered species and other species to be protected)

- Cultural/archaeological and historical resource protection

- Solid waste management/disposal, including the recycling and salvage of materials (the EPP can reference the required Solid Waste Management Plan and Report identified in 1.7 above).

- Stormwater management and control (storm water pollution prevention plan, if required) addressing soils, geology, and topography protection (erosion and sediment control)

- Wastewater management

- Air pollution control (e.g., dirt and dust) Submit truck and material haul routes along with a Dirt and Dust Control Plan for controlling dirt, debris, and dust on Installation roadways. As a minimum, identify in the plan the subcontractor and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

- Identify portable and stationary internal combustion engines that will be supplied, used or serviced. At minimum, include the make, model, serial number, manufacture date, size (engine brake horsepower), and emission certification status of each engine. Maintain applicable records and log hours of operation and fuel use. Logs must include reasons for operation and delineate between emergency and non-emergency operation.

- Planned air pollution-generating equipment and processes and management control measures (including, but not limited to, spray painting, abrasive blasting, demolition, material handling, fugitive dust, and fugitive emissions). Log hours of operations and track quantities of materials used.

- Identify management practices to address heating, ventilation, and air conditioning (HVAC) work involving refrigerants. Technicians must be certified, maintain copies of certification on site, use certified equipment and log work that requires the addition or removal of refrigerant. Any refrigerant reclaimed is the property of the Government, coordinate with the Installation Environmental Department to determine the appropriate turn in location.

- Spill prevention and planned actions in the event of a spill

- Hazardous materials and hazardous waste containment/storage and disposal

- Water pollution protection (i.e. groundwater, streams, rivers, lakes and other water bodies)

- Emergency planning

- Management practices for handling refrigerants (Any refrigerant reclaimed is the property of the Government, coordinate with the Installation Environmental Department to determine the appropriate turn in location.

- Other concerns specific to the project (i.e. noise, in-water dredging and/or pile installments, traffic and transportation)

- Community engagement, if applicable

Provide the Government a list of SDSs for all hazardous materials proposed for use on site. The Government may alter or limit use of specific materials as needed to meet installation requirements for emissions.

Drawings showing locations of proposed temporary excavations or embankments for haul roads, water crossings, wetlands, cultural resources, material storage areas, structures, sanitary facilities, storm drains and conveyances, and stockpiles of excess soil.

Work area plan showing the proposed activity in each portion of the area and identify the areas of limited use or nonuse. Include measures for marking the limits of use areas, including methods for protection of features to be preserved within authorized work areas and methods to control runoff and to contain materials on site, and a traffic control plan.

The duties and level of authority assigned to the person(s) on the job site who oversee environmental compliance, such as who is responsible for adherence to the EPP, who is responsible for spill cleanup and training personnel on spill response procedures, who is responsible for manifesting hazardous waste to be removed from the site, and who is responsible for training the Contractor's personnel.

Employee Training Information

Emergency and Contact Information

A letter signed by an officer of the firm appointing the EC and stating that person is responsible for managing and implementing the Environmental Program and EPP as described in this contract. Include in this letter the ECs authority to direct the removal and replacement of non-conforming work.

1.9 ENVIRONMENTAL RECORDS BINDER

Maintain on-site a separate three-ring Environmental Records Binder and submit at the completion of the project. Make separate parts within the binder that correspond to each submittal listed under paragraph CLOSEOUT SUBMITTALS in this section.

1.10 PESTICIDE DELIVERY, STORAGE, AND HANDLING

1.10.1 Delivery and Storage

Deliver pesticides to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Store pesticides according to manufacturer's instructions and under lock and key when unattended.

1.10.2 Handling Requirements

Formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and use the clothing and personal protective equipment specified on the labeling for use during each phases of the application. Furnish SDSs for pesticide products.

1.11 FACILITY HAZARDOUS WASTE GENERATOR STATUS

The Department of Defense considers a generator to be the installation, or activity on an installation, that produces hazardous waste. Meet FGS Chapter 6 requirements for any work conducted within the boundaries of this Installation. Comply with provisions of the FGS and Installation Hazardous Waste Management Plan applicable to this generator status

regarding training and storage, handling, and disposal of construction derived wastes.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitats. Prior to the commencement of activities, consult with the Installation Environmental Department, regarding rare species or sensitive habitats that need to be protected. The protection of rare, threatened, and endangered animal and plant species identified, including their habitats, is the Contractor's responsibility.

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work that is consistent with the requirements of the Installation Environmental Department or as otherwise specified. Confine construction activities to within the limits of the work indicated or specified.

3.1.1 Flow Ways

Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as specified.

3.1.2 Vegetation

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attached ropes, cables, or guys is authorized, the Contractor is responsible for any resultant damage.

Protect existing trees that are to remain to ensure they are not injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. Coordinate with the Contracting Officer and Installation Environmental Department to determine appropriate action for trees and other landscape features scarred or damaged by equipment operations.

3.1.3 Streams

Stream crossings must allow movement of materials or equipment without violating water pollution control standards of the FGS. Construction of stream crossing structures must be in compliance with any required Host Nation permits.

The Contracting Officer's approval and appropriate permits are required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Obtain Contracting Officer's approval prior to installation.

Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition unless otherwise required by the Contracting Officer.

3.2 STORMWATER

Do not discharge stormwater from construction sites to the sanitary sewer. If the water is noted or suspected of being contaminated, it may only be released to the storm drain system if there is no obvious sheen or odor that indicates the discharge is contaminated and the stormwater is filtered using best management practices to filter out potential contaminants including solids. Obtain authorization in advance from the Installation Environmental Department for any release of contaminated water.

Inspect and maintain road gullies and basin inserts present at the site and ensure no pollutants are entering into the system. Educate and train the contractor's personnel in following facility wide good housekeeping/pollution prevention management practices. No washing of vehicles/equipment authorized on base. Maintain dry and clean floors and ground surfaces. Regularly pickup garbage and properly dispose of waste material. Store hazardous materials and equipment that may release pollutants to the storm system under cover. Inspect and maintain facility equipment and systems to uncover conditions that could cause breakdown or failures resulting in discharge of pollutants.

Routinely inspect for leaks of materials that have a high pollution potential. Ensure that spill cleanup procedures are understood by all personnel Provide adequate aisle space to facilitate material transfer and provide easy access for inspections. Store hazardous materials, hazardous waste and petroleum, lubricants and oil drums away from high traffic areas to prevent accidental spills. Store hazardous materials, hazardous waste and petroleum, lubricants and oil drums off the ground to prevent corrosion due to moisture (See Hazardous Material). Assign the responsibility of hazardous material inventory and training to designated personnel and limit hazardous material handling to qualified personnel.

3.2.1 Stormwater Pollution Prevention Plan

Comply with the Installation Stormwater Pollution Prevention Plan and Chapter 4 of the FGS. Address stormwater pollution prevention elements in the EPP.

3.2.1.1 Inspection Reports

Submit "Inspection Reports" to the Contracting Officer.

3.2.1.2 Stormwater Pollution Prevention Plan Compliance Notebook

Create and maintain a three ring binder of documents that demonstrate compliance with the EPP and FGS Chapter 4. Include a copy of the SWPPP, if one is required and SWPPP update amendments, inspection reports and related corrective action records, and copies of any correspondence the binder. At project completion, the notebook becomes the property of the Government. Provide the compliance notebook to the Contracting Officer.

3.2.1.3 Stormwater Notice of Completion for Construction Activities

Submit a Notice of Completion to the Contracting Officer for approval once

construction is complete and final stabilization has been achieved on all portions of the site for which the Contractor is responsible. Prepare as-built topographic survey and provide to the Contracting Officer.

3.2.2 Erosion and Sediment Control Measures

Implement erosion and sediment control measures identified in the EPP. Preserve vegetation to the maximum extent practicable. Erosion control inspection reports may be compiled as part of a stormwater pollution prevention plan inspection reports.

3.2.2.1 Erosion Control

Prevent erosion by mulching, compost blankets, geotextiles, temporary slope drains, or other best management practices. Stabilize slopes by sodding, seeding, chemical stabilization or such combination of these methods necessary for effective erosion control. Use of hay bales is prohibited.

3.2.2.2 Sediment Control Practices

Implement sediment control practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement sediment control practices prior to soil disturbance and prior to creating areas with concentrated flow, during the construction process to minimize erosion and sediment laden runoff. Include the following devices: silt fences, temporary diversion dikes, storm drain inlet protection, and other best management practices or in combination for sediment control. Location and details of installation and construction are indicated on the drawings.

3.2.3 Work Area Limits

Mark the areas that need not be disturbed under this Contract prior to commencing construction activities. Mark or fence isolated areas within the general work area that are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. Personnel must be knowledgeable of the purpose for marking and protecting particular objects.

3.2.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Contracting Officer. Move or relocate the Contractor facilities only when approved by the Government. Provide erosion and sediment controls for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Control temporary excavation and embankments for plant or work areas to protect adjacent areas.

3.3 SURFACE AND GROUNDWATER

3.3.1 Cofferdams, Diversions, and Dewatering

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure must be constantly controlled to maintain compliance with existing Host Nation standards and designated uses of the surface water body. Do not discharge excavation ground water to the

sanitary sewer, storm drains, or to surface waters without prior specific authorization in writing from the Installation Environmental Department. Discharge of hazardous substances will not be permitted under any circumstances. Use sediment control BMPs to prevent construction site runoff from directly entering any storm drain or surface waters.

If the construction dewatering is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is treated and authorized by the Installation Environmental Department. Discharge of hazardous substances will not be permitted under any circumstances.

3.3.2 Surface Waters

Do not enter, disturb, destroy, or allow discharge of contaminants into surface waters except as authorized herein. The protection of surface waters shown on the drawings is the Contractor's responsibility. Authorization to enter specific waters identified does not relieve the Contractor from any obligation to protect other waters within, adjacent to, or in the vicinity of the construction site and associated boundaries.

3.4 PROTECTION OF CULTURAL RESOURCES

3.4.1 Archaeological Resources

Existing archaeological resources within the work area are shown on the drawings. Protect these resources and be responsible for their preservation during the life of the Contract. If, during excavation or other construction activities, any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, activities that may damage or alter such resources will be suspended. Resources covered by this paragraph include, but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources. The Government retains ownership and control over archaeological resources.

3.4.2 Historical Resources

Existing historical resources within the work area are shown on the drawings. Protect these resources and be responsible for their preservation during the life of the Contract.

3.5 AIR RESOURCES

3.5.1 Oil or Dual-fuel Boilers and Furnaces

Provide product data and details for new, replacement, or relocated fuel fired boilers, heaters, or furnaces to the Installation Environmental Department through the Contracting Officer. Data to be reported include: equipment purpose (water heater, building heat, process), manufacturer,

model number, serial number, fuel type (oil type, gas type) size (MMBTU heat input).

3.5.2 Burning

Burning is prohibited on the Government premises.

3.5.3 Class I and II ODS Prohibition

Class I and II ODS are Government property and must be returned to the Government for appropriate management. Coordinate with the Installation Environmental Department to determine the appropriate location for turn in of all reclaimed refrigerant.

3.5.4 Accidental Venting of Refrigerant

Accidental venting of a refrigerant is a release and must be reported immediately to the Contracting Officer. Any class I or class II ODS, HFC, and PFC refrigerant listed in Tables 2.2 and 2.3 shall not be intentionally released in the course of maintaining, servicing, repairing, or disposing of appliances, industrial process refrigeration units, air conditioning units, or motor vehicle air conditioners.

All repairs, including leak repairs or services to appliances, industrial process refrigeration units, air conditioning units, or motor vehicle air conditioners, must be performed using commercially available refrigerant recovery/recycling equipment operated by trained personnel.

3.5.5 Certification Requirements

Heating and air conditioning technicians must be certified through a recognized industry standard program. Maintain copies of certifications at the employees' places of business; technicians must carry certification wallet cards.

3.5.6 Dust Control

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.5.6.1 Particulates

Dust particles, aerosols and gaseous by-products from construction activities, and processing and preparation of materials (such as from asphaltic batch plants) must be controlled at all times, including weekends, holidays, and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates that would exceed FGS standards or that would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators, or other methods will be permitted to control particulates

in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs.

3.5.7 Abrasive Blasting

Blasting operations cannot be performed without prior approval of the Installation Environmental Department. The use of silica sand is prohibited in sandblasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive agent, paint chips, and other debris. Perform work involving removal of hazardous material in accordance with Chapter 5 of the FGS.

3.5.8 Odors

Control odors from construction activities. The odors may not constitute a health hazard.

3.6 WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of waste. Include procedures for pollution prevention/hazardous waste minimization in the Hazardous Waste Management Section of the EPP. Obtain a copy of the installation's Pollution Prevention/Hazardous Waste Management Plan for reference material when preparing this part of the EPP. If no written plan exists, obtain information by contacting the Contracting Officer. Describe the anticipated types of the hazardous materials to be used in the construction when requesting information. Assign the responsibility of hazardous material inventory and training to ranking/supervisory personnel and limit hazardous material handling to qualified personnel.

3.6.1 Salvage, Reuse and Recycle

Identify anticipated materials and waste for salvage, reuse, and recycling. Describe actions to promote material reuse, resale or recycling. To the extent practicable, all scrap metal must be sent for reuse or recycling and will not be disposed of in a landfill.

Include the name, physical address, and telephone number of the hauler, if transported by a franchised solid waste hauler and include the destination.

Separate all recyclables (aluminum cans, PET bottles etc.) from the debris and rubbish resulting from the work under this contract and turn-in and place it in respective recycling receptacles.

Contractor shall follow the base Qualified Recycling Program (QRP) Instruction. Scrap materials (used Recyclable materials such as scrap metal, scrap A/Cs) generated as a result of on-base work shall be turned in to Isa Air Base Environmental Department. The contractor shall ensure that their staff follows the base Qualified Recycling Program (QRP) Instruction in identifying the recyclable materials and to properly use the recycling receptacles placed onboard. All solid wastes or materials that have been separated for the purpose of recycling will be stored in such a manner that they do not constitute a fire, health or safety hazard or provide food or harborage for vectors, and will be contained or bundled and covered to avoid spillage.

3.6.2 Nonhazardous Solid Waste Diversion Report

Maintain an inventory of nonhazardous solid waste diversion and disposal of construction and demolition debris. Submit a report to the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that nonhazardous solid waste has been generated.

Report the total quantity of Construction and Demolition debris and rubbish disposed, recycled or reclaimed and the cost involved with each of these management procedures to the Isa Air Base Environmental Department. The Project/Construction Manager shall report this data to the Environmental Department in the specified form (blank form available at Environmental Department).

3.7 WASTE MANAGEMENT AND DISPOSAL

3.7.1 Waste Determination Documentation

Complete a Waste Determination form (provided at the pre-construction conference) for Contractor-derived wastes to be generated. All potentially hazardous solid waste streams that are not subject to a specific exclusion or exemption from the hazardous waste regulations (e.g. scrap metal, domestic sewage) or subject to special rules, (lead-acid batteries and precious metals) must be characterized in accordance with the requirements of Chapter 6 of the FGS. Base waste determination on user knowledge of the processes and materials used, and analytical data when necessary. Consult with the Installation environmental staff for guidance on specific requirements. Attach support documentation to the Waste Determination form. As a minimum, provide a Waste Determination form for the following waste (this listing is not inclusive): oil- and latex -based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and containers of the original materials.

3.7.1.1 Sampling and Analysis of Waste

3.7.1.1.1 Waste Sampling

Sample waste in accordance with Chapter 6 of the FGS. Clearly mark each sampled drum or container with the Contractor's identification number, and cross reference to the chemical analysis performed. Consult with the Installation environmental staff for guidance on specific requirements.

3.7.1.1.2 Laboratory Analysis

Follow the analytical procedure and methods in accordance with the Chapter 6 of the FGS. Provide analytical results and reports performed to the Contracting Officer. Consult with the Installation environmental staff for guidance on specific requirements.

3.7.1.1.3 Analysis Type

At a minimum, identify hazardous waste by analyzing for the following characteristics: ignitability, corrosivity, reactivity, toxicity based on TCLP results. Consult with the Installation environmental staff for guidance on specific requirements.

3.7.2 Solid Waste Management

3.7.2.1 Solid Waste Management Report

Provide copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, a statement indicating the disposal location for the solid waste that is signed by an employee authorized to legally obligate or bind the firm may be submitted. The sales documentation and Contractor certification must include the receiver's applicable tax identification number and business, registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained for the Contractor's own use, submit the information previously described in this paragraph on the solid waste disposal report. Prices paid or received do not have to be reported to the Contracting Officer unless required by other provisions or specifications of this Contract.

3.7.2.2 Control and Management of Solid Wastes

Pick up solid wastes, and place in covered containers that are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with non-hazardous solid waste. Transport solid waste off Government property and dispose of it in compliance with Chapter 7 of the FGS for solid waste disposal. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Haul waste materials to the landfill site shown on the drawings or designated by the Contracting Officer. Comply with site procedures. Segregate and separate treated wood components disposed at a lined landfill approved to accept this waste in accordance with Host Nation regulations. Disposal must comply with Host Nation regulations. Contact the Isa Air Base Environmental Department for any support in characterizing the waste material. The disposal of waste materials generated onsite shall be coordinated through the Isa Air Base Environmental Department.

3.7.3 Control and Management of Hazardous Material

Manage hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, in accordance with Chapter 5 of the FGS. Do not dispose of hazardous waste on Government property. Do not discharge any waste to a sanitary sewer, storm drain, or to surface waters or conduct waste treatment or disposal on Government property without written approval of the Contracting Officer.

3.7.3.1 Hazardous Waste/Debris Management

Identify construction activities that will generate hazardous waste or debris. Provide a documented waste determination for resultant waste streams. Identify, label, handle, store, and dispose of hazardous waste or debris in accordance with Chapter 6 of the FGS.

Manage hazardous waste in accordance with the approved Hazardous Waste Management Section of the EPP. Store hazardous wastes in approved containers in accordance with Chapter 6 of the FGS. Hazardous waste generated within the confines of Government facilities is identified as

being generated by the Government. Prior to removal of any hazardous waste from Government property, hazardous waste manifests must be signed by personnel from the Installation Environmental Department. Do not bring hazardous waste onto Government property. Provide the Contracting Officer with a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in Chapter 6 of the FGS.

3.7.3.2 Waste Storage/Satellite Accumulation/90 Day Storage Areas

Accumulate hazardous waste at satellite accumulation points and in compliance with Chapter 6 of the FGS. Individual waste streams will be limited to 208 liter (55 gallons) of accumulation (or 0.95 liter (1 quart) for acutely hazardous wastes). If the Contractor expects to generate hazardous waste at a rate and quantity that makes satellite accumulation impractical, the Contractor may request a temporary 90 day accumulation point be established. Submit a request in writing to the Contracting Officer and provide the following information (Attach Site Plan to the Request):

Contract Number [_____]
Contractor [_____]
Haz/Waste or Regulated Waste POC [_____]
Phone Number [_____]
Type of Waste [_____]
Source of Waste [_____]
Emergency POC [_____]
Phone Number [_____]
Location of the Site [_____]

Attach a Waste Determination form for the expected waste streams. Allow 10 working days for processing this request. Additional compliance requirements (e.g. training and contingency planning) that may be required are the responsibility of the Contractor. Barricade the designated area where waste is being stored and post a sign identifying as follows:

"DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

3.7.3.3 Hazardous Waste Disposal

3.7.3.3.1 Responsibilities for Contractor's Disposal

No hazardous waste shall be disposed of on government property. No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract. The government is not responsible for disposal of Contractor's waste material brought on the job site and not required in the performance of this contract.
The Contractor is not authorized to discharge any materials to the sanitary sewer, storm drain, or conduct waste treatment or disposal on government property.

Contact the Isa Air Base Environmental Department for any support in characterizing the waste material. The disposal of waste materials generated onsite shall be coordinated through Isa Air Base Environmental Department. All hazardous waste generated on base by the contractor's activity under the contract shall be disposed of in accordance with Isa Air Base Bahrain Environmental waste Management Standard Operation Procedures (SOP). The Contractor must coordinate the disposal of hazardous

waste with the Environmental Department and turn in a copy of the disposal documents such as DD1348-1A, and SDS to the Isa Air Base Environmental Department.

Contractor shall turn in mercury containing fluorescent light bulbs to the Environmental Department for proper disposal

3.7.3.3.1.1 Services

Provide service necessary for the final treatment or disposal of the hazardous material or waste in accordance with Chapters 5 and 6 of the FGS and the terms and conditions of the Contract within 60 days after the materials have been generated. These services include necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal or transportation, include manifesting or complete waste profile sheets, equipment, and compile documentation).

3.7.3.3.1.2 Samples

Obtain a representative sample of the material generated for each job done to provide waste stream determination.

3.7.3.3.1.3 Analysis

Analyze each sample taken and provide analytical results to the Contracting Officer. See paragraph WASTE DETERMINATION DOCUMENTATION.

3.7.3.3.1.4 Labeling

Determine the proper shipping names for waste (each container requiring disposal) and demonstrate to the Contracting Officer how this determination is developed and supported by the sampling and analysis requirements contained herein. Label all containers of hazardous waste with the words "Hazardous Waste" in English and the Host Nation language or other words to describe the contents of the container in accordance with Chapter 6 of the FGS.

3.7.3.3.2 Contractor Disposal Turn-In Requirements

Hazardous waste generated must be disposed of in accordance with the following conditions to meet installation requirements:

a. Drums must be compatible with waste contents and drums must meet requirements for transportation of materials.

b. Band drums to wooden pallets.

c. No more than three 208 liter (55 gallon) drums or two 321 liter (85 gallon) over packs are to be banded to a pallet.

d. Band using 32 millimeters (1-1/4 inch) minimum band on upper third of drum.

e. Provide label in accordance with the FGS.

f. Leave 7 to 12 centimeters (3 to 5 inches) of empty space above volume of material.

3.7.3.4 Universal Waste Management

Manage the following categories of universal waste in accordance with the FGS and installation instructions:

a. Batteries

b. Lamps

c. Mercury-containing equipment

d. Pesticides

Mercury is prohibited in the construction of this facility, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed.

3.7.3.5 Electronics End-of-Life Management

Recycle or dispose of electronics waste, including, but not limited to, used electronic devices such computers, monitors, hard-copy devices, televisions, mobile devices, in accordance with the FGS and installation instructions.

3.7.3.6 Disposal Documentation for Hazardous and Regulated Waste

Contact the Contracting Officer for the facility identification number that is to be used on each manifest.

Submit a copy of applicable license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities. Hazardous or toxic waste manifests must be reviewed, signed, and approved by the Contracting Officer before the Contractor may ship waste. To obtain specific disposal instructions, coordinate with the Installation Environmental Department.

3.7.4 Releases/Spills of Oil and Hazardous Substances and Aqueous Film Forming Foam (AFFF)

3.7.4.1 Response and Notifications

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated in accordance with Chapter 16 of the FGS and the Installation Spill Prevention Plan. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release. In the event of any releases of oil and hazardous substances, chemicals, or gases; and control/response beyond capabilities immediately (within 15 minutes) notify the Installation Fire Department, the Installation Command Duty Officer, the Installation Environmental Office, and the Contracting Officer. If spills can be controlled using in-house capabilities, cleanup the spills and notify the Installation Environmental Office.

Submit verbal and written notifications as required by Installation instructions and Spill Prevention Plan immediately. Spill response must be in accordance with Chapter 16 of the FGS and the Installation Spill Prevention Plan. Contain and clean up these spills without cost to the Government.

The person discovering/causing the spill shall conduct the following immediate first responder actions as appropriate; but only if properly trained and they can be done safely:

- Shutdown all appropriate manifold storage tank and truck valves and/or pumps.

- Restrict all ignition sources and utilize spill control devices and equipment.

- Notify supervisor and people working nearby; and evacuate the immediate area to a safe distance upwind.

- Aid exposed personnel by assisting in safely removing personnel from immediate spill area, and requesting medical assistance for an ambulance (as needed)

- Secure storm drains, if any with storm drain covers or diversion barriers.

If spill can be contained and cleaned up using available spill kit/supplies and trained manpower capabilities, complete response operations/clean up the spill, if it is safe to do so. Then report incidents to base Environmental Department. If the spill exceeds response capabilities and need further assistance, call 1785-4911 (Isa Air Base) and 1795-4911 (ISA AB).

While reporting provide as much of the following information as possible:

- Name, telephone number, and identification of caller;

- Time and location of spill;

- Identity and quantity of spill materials;

- Origin and cause of spill;

- Description of spill (behavior of spill, affected areas);

- Anticipated movement of spill;

- Planned or initiated actions;

- Type of assistance required;

- Stay in the area, if it is safe to do so, until FRT arrives and direct them to the spill; and

- Provide SDSs as needed.

Report any Aqueous Film Forming Foam (AFFF) intentional or unintentional releases at any location (regardless of any amount) to the Environmental

Department.

3.7.4.2 Clean Up

Maintain spill cleanup equipment and materials at the work site. Clean up hazardous and non-hazardous waste spills. Reimburse the Government for costs incurred including sample analysis materials, clothing, equipment, and labor if the Government will initiate its own spill cleanup procedures, for Contractor- responsible spills, when: Spill cleanup procedures have not begun within one hour of spill discovery/occurrence; or, in the Government's judgment, spill cleanup is inadequate and the spill remains a threat to human health or the environment.

3.7.5 Mercury Materials

Immediately report to the Environmental Department and the Contracting Officer instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the Contracting Officer.

Do not recycle a mercury spill cleanup; manage it as a hazardous waste for disposal.

3.7.6 Wastewater

Disposal of wastewater must be as specified below.

3.7.6.1 Treatment

Do not allow wastewater from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, and forms to enter water ways or to be discharged prior to being treated to remove pollutants. Dispose of the construction-related waste water off-Government property by collecting and placing it in a retention pond where suspended material can be settled out or the water can evaporate to separate pollutants from the water. The site for the retention pond must be coordinated and approved with the Environmental Department and Contracting Officer. The residue left in the pond prior to completion of the project must be removed, tested, and disposed of off-Government property in accordance with Chapter 6 of the FGS. Backfill the area to the original grade, top-soiled, and seeded or sodded. Coordinate with the Environmental Department on test requirements for the water in the retention pond for and have the results reviewed and approved by the Contracting Officer prior to being discharged or disposed of off-Government property.

3.7.6.2 Surface Discharge

For discharge of ground water obtain authorization from the Environmental Department prior to surface discharging.

3.7.6.3 Land Application

Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing may be land-applied after de-chlorination or discharged into the sanitary sewer with prior approval and notification to the Wastewater Treatment Plant's Operator.

3.8 HAZARDOUS MATERIAL MANAGEMENT

Include hazardous material control procedures in the Safety Plan, in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. Do not bring hazardous material onto Government property that does not directly relate to requirements for the performance of this contract. Submit an SDS and estimated quantities to be used for each hazardous material to the Contracting Officer prior to bringing the material on the installation for base Environmental /Safety/Industrial Hygienist/HAZMAT review/approval. Typical materials requiring SDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. Use hazardous materials in a manner that minimizes the amount of hazardous waste generated. Containers of hazardous materials must have National Fire Protection Association labels or their equivalent. Certify that hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste, in accordance with Chapter 6 of the FGS.

3.8.1 Contractor Hazardous Material Inventory Log

Submit the "Contractor Hazardous Material Inventory Log"(found at: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-57-19 which provides information required by (EPCRA Sections 312 and 313) along with corresponding SDS, to the Contracting Officer at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Keep copies of the SDSs for hazardous materials onsite. At the end of the project, provide the Contracting Officer with copies of the SDSs, and the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used.

The Contracting Officer may request documentation for any spills or releases, environmental reports, or off-site transfers.

3.9 PREVIOUSLY USED EQUIPMENT

Clean previously used construction equipment prior to bringing it onto the project site. Equipment must be free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds.

3.10 CONTROL AND MANAGEMENT OF ASBESTOS-CONTAINING MATERIAL (ACM)

Manage and dispose of asbestos- containing waste in accordance with Chapter 14 of the FGS. Refer to Manifest asbestos-containing waste and provide the manifest to the Contracting Officer. Notifications to the state and Installation Air Program Manager are required before starting any asbestos work.

The contractor needs to contact the Public Works Asbestos Program Manager and Environmental Department in identifying Asbestos Containing Material (ACM) locations and procedures to follow during any construction/maintenance to ensure ACM detected areas are managed properly. If asbestos is found at any stage of the project in confined areas or left unnoticed during the environmental survey - DO NOT disturb the area, stop work in the area of the questionable material or condition

and notify both the Contracting Officer and Environmental Department immediately for further guidance. Sealant and adhesives used in the project must not contain asbestos. Submit a certificate proving the asbestos-free nature of products for materials that suspect asbestos-containing materials (Sealant, Adhesives, gasket etc.).

3.11 CONTROL AND MANAGEMENT OF LEAD-BASED PAINT (LBP)

Manifest any lead-contaminated waste and provide the manifest to the Contracting Officer.

3.12 CONTROL AND MANAGEMENT OF POLYCHLORINATED BIPHENYLS (PCBS)

Manage and dispose of PCB-contaminated waste in accordance with Chapter 13 of the FGS.

3.13 MILITARY MUNITIONS

In the event military munitions, as defined in 40 CFR 260, are discovered or uncovered, immediately stop work in that area and immediately inform the Contracting Officer.

3.14 PETROLEUM, OIL, LUBRICANT (POL) STORAGE AND FUELING

POL products include flammable or combustible liquids, such as gasoline, diesel, lubricating oil, used engine oil, hydraulic oil, mineral oil, and cooking oil. Store POL products and fuel equipment and motor vehicles in a manner that affords the maximum protection against spills into the environment. Manage and store POL products in accordance with Chapter 9 of the FGS. Use secondary containments, dikes, curbs, and other barriers, to prevent POL products from spilling and entering the ground, storm or sewer drains, stormwater ditches or canals, or Host Nation waters. Describe in the EPP how POL tanks and containers will be stored, managed, and inspected and what protections will be provided. Storage of oil, including fuel, on the project site is not allowed. Fuel must be brought to the project site each day that work is performed. Storage of fuel on the project site must be in accordance with paragraph OIL STORAGE INCLUDING FUEL TANKS.

3.14.1 Used Oil Management

Manage used oil generated on site in accordance with FGS Chapter 9. Determine if any used oil generated while onsite exhibits a characteristic of hazardous waste. Used oil containing 1,000 parts per million of solvents is considered a hazardous waste and disposed of at the Contractor's expense. Used oil mixed with a hazardous waste is also considered a hazardous waste. Dispose in accordance with paragraph HAZARDOUS WASTE DISPOSAL. Contractor's can turn-in used oil that meet the recycling criteria to the Environmental Department for recycling.

3.14.2 Oil Storage Including Fuel Tanks

Provide secondary containment and overfill protection and flow shut off valve for oil storage tanks. A berm used to provide secondary containment must be of sufficient size and strength to contain the contents of the tanks plus 12 centimeters (5 inches) freeboard for precipitation. Construct the berm to be impervious to oil for 72 hours that no discharge will permeate, drain, infiltrate, or otherwise escape before cleanup occurs. Use drip pans during oil transfer operations; adequate absorbent

material must be onsite to clean up any spills and prevent releases to the environment. Cover tanks and drip pans during inclement weather. Provide procedures and equipment to prevent overfilling of tanks. If tanks and containers with an aggregate aboveground capacity greater than 5,000 liter (1,320 gallons) will be used onsite (only containers with a capacity of 208 liter (55 gallons) or greater are counted), provide and implement a SPCC plan meeting the requirements of Chapter 16 of the FGS. Do not bring underground storage tanks to the installation for Contractor use during a project. Submit the SPCC plan to the Contracting Officer for approval.

Proper labels are required on POL storage containers (Flammable, No Smoking, Capacity of tank, Type of POL etc.).

Generator (if inbuilt tank is not double walled and not equipped with overfill protection and shut off valve) and other fuel assemblies will be placed on a secondary containment and drainage of storm water from containment areas will be controlled by a valve that is locked closed when not in active use. Stormwater will be inspected for petroleum sheen before being drained from containment areas. If petroleum sheen is present it must be collected with sorbent materials prior to drainage, or treated using an oil-water separator. Sorbent material shall be disposed of in accordance with Isa Air Base Bahrain Environmental waste Management Standard Operation Procedures (SOP).

All flammable tanks shall be grounded properly to withstand the static current that may be generated during fuel transfer (the FGS and UFC 3-460-03 address grounding and bonding of fuel oil storage tanks and fuel transfers).

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. All fueling operations including fuel delivery on base shall follow fuel management Standard Operating Procedure (SOP) prepared by the Isa Air Base Environmental Department.

3.15 INADVERTENT DISCOVERY OF PETROLEUM-CONTAMINATED SOIL OR HAZARDOUS WASTES

If petroleum-contaminated soil, groundwater or suspected hazardous waste is found during construction that was not identified in the Contract documents, immediately notify the Contracting Officer. Do not disturb this material until authorized by the Contracting Officer.

3.16 CHLORDANE

Evaluate excess soils and concrete foundation debris generated during the demolition of housing units or other wooden structures for the presence of chlordane or other pesticides prior to reuse or final disposal.

3.17 SOUND INTRUSION

Make the maximum use of low-noise emission products. Blasting or use of explosives are not permitted without written permission from the Contracting Officer, and then only during the designated times. Confine pile driving from 8 a.m. and 4 p.m., Monday through Friday, exclusive of holidays, unless otherwise specified. Keep construction activities under surveillance and control to minimize environment damage by noise.

3.18 POST CONSTRUCTION CLEANUP

Clean up areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, remove traces of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade parking area and similar temporarily used areas to conform to surrounding contours.

3.19 PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, coordinate with the Installation Pest Management Coordinator (IPMC) or Project Pesticide Coordinator (PPC), through the Contracting Officer, at the earliest possible time prior to pesticide application. Discuss integrated pest management strategies with the IPMCPPC and receive concurrence from the IPMCPPC through the Contracting Officer prior to the application of any pesticide associated with these specifications. Provide Installation Project Office Pest Management personnel the opportunity to be present at meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under the Installation Integrated Pest Management Plan (IPMP).

3.19.1 Application

Inspections and pesticide applications shall be performed using a certified pesticide applicator in accordance with the Installation Pest Management Plan. The certified applicator must wear clothing and personal protective equipment as specified on the pesticide label. The Contracting Officer will designate locations for water used in formulating. Do not allow the equipment to overflow. Inspect equipment for leaks, clogging, wear, or damage and repair prior to application of pesticide.

3.19.2 Pesticide Treatment Plan

Include and update a pesticide treatment plan, as information becomes available. Include in the plan the sequence of treatment, dates, times, locations, pesticide trade name, registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (that is, pounds of active ngredient applied), equipment used for application and calibration of equipment. Comply with the IPMP record-keeping and reporting requirements as well as any additional Installation Project Office specific requirements in conformance with DA AR 200-1 Chapter 5, Pest Management, Section 5-4 "Program requirements" for data required to be reported to the Installation.

3.20 POST CONSTRUCTION CLEANUP

Clean up areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, remove traces of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade parking area and similar temporarily used areas to conform to surrounding contours.

3.21 LAYDOWN AREA

The contractor laydown area will be subjected to periodic environmental inspections to ensure compliance with applicable environmental regulations. During demobilization and prior to returning the laydown area back to Government, a walk through site inspection shall be coordinated well ahead of time with the Environmental Department to ensure the area is free from contamination/spills, etc. If required, remediation processes will be conducted at contractor's expense.

3.22 DRINKING WATER

During drinking water related projects, Use only lead-free pipe, solder, flux, and fittings in the installation or repair of water systems and plumbing systems for drinking water. Maximum lead content of 0.2% for solder and flux, and 8.0% for pipes and fittings is authorized.

a. Solder/flux intended to use on project must be submitted to the Environmental Department for approval.

b. Testing is required if material is made OCONUS to ensure it meets FGS Criteria.

Consult the PWD to see if the water distributed on board is declared Fit for Human Consumption. Any looping to the existing water distribution line shall be coordinated with the PWD. Contractor shall ensure Cross Connection (CC) control inspections are done and Back Flow Prevention (BFP) devices are properly installed and certified prior to looping or installation of any new plumbing devices to the distribution line. Make sure contract personnel activities shall not cause any contamination to the water distributed onboard. All new pipelines shall be flushed in accordance with an approved flushing Plan that follows the Requirements of American Water Works Association Standard 651 for Disinfecting Water Mains latest edition. Flushing plan shall be submitted to the installation water management board for review/approval.

Upon completion of project, contractor shall coordinate with Environmental and medical to arrange for residual chlorine and lead swab (on fixtures, solder etc.) testing a minimum of 24 hours in advance. Use energy/water conservation products (such as energy star, high efficiency - low flow flushing system etc.). Coordinate with the PWD, UEM Energy Manager. Water distributed onboard shall not be used for any construction purpose.

3.23 EXHIBIT

Exhibit A - Kingdom Of Bahrain Final Governing Standards (FGS)

-- End of Section --

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KINGDOM OF BAHRAIN
FINAL GOVERNING STANDARDS

13 March 2012

Prepared by
U.S. Navy Central Command
United States Central Command

On behalf of
United States Central Command (USCENTCOM)

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FORWARD

This Department of Defense (DoD) Publication is issued under the authority and requirements of DoD Instruction (DoDI) 4715.5, "Management of Environmental Compliance at Overseas Installations," April 22, 1996. This Final Governing Standard (FGS) provides criteria, standards, and management practices for environmental compliance at DoD installations in the Kingdom of Bahrain. The FGS is derived from DoD 4715.05-G, "Overseas Environmental Baseline Guidance Document," dated May 2007.

To produce the FGS for the Kingdom of Bahrain, a comprehensive review of the host nation's environmental regulations was conducted. A review was also conducted of Gulf Cooperation Council (GCC) environmental requirements of which the Kingdom of Bahrain is a party. Furthermore, any treaty, convention, protocols, etc., of which the Kingdom of Bahrain may be a party to, were also reviewed. The regulatory analysis consisted of reviewing each regulation that included an environmental requirement, per the scope of the OEBGD. Thus, the Kingdom of Bahrain's occupational or industrial health and safety regulations were not addressed as they are not part of the 16 OEBGD chapters. Local regulations were not included as part of the regulatory review.

This FGS applies to the Office of the Secretary of Defense, the Military Departments, the Chairman of the Joint Chiefs of Staff, the Combatant Command, the Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all other organizational entities within the Department of Defense (hereafter referred to collectively as the "DoD Components") operating in the Kingdom of Bahrain.

This FGS is effective immediately and its use is mandatory by the DoD Components, pursuant to DoDI 4715.5. The Heads of the DoD Components may only issue supplementary instructions when deemed necessary to provide for unique requirements within their organizations.

FOR THE COMMANDER:

KARL R. HORST
Major General, U.S. Army
Chief of Staff

METHODOLOGY

Chapters 2-19 of the FGS include scope, definitions and criteria. Appendices and tables are also presented. The applicable Kingdom of Bahrain environmental regulations were compared to the May 2007 Overseas Environmental Baseline Guidance Document (OEBGD), and determinations were made as to whether an environmental regulation of the Kingdom of Bahrain was more or less stringent, equivalent to, or in addition to, the OEBGD standard. The more restrictive and additional standards were adopted in this FGS.

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APPENDICES

TABLES

REFERENCES

Department of Defense

(a) DoD Instruction 4715.5, "Management of Environmental Compliance at Overseas Installations," April 22, 1996
(b) Executive Order 12344, "Naval Nuclear Propulsion Program," February 1, 1982
(c) Section 7158 of title 42, United States Code
(d) Executive Order 12114, "Environmental Effects Abroad of Major Federal Actions," January 4, 1979
(e) DoD Instruction 4715.4, "Pollution Prevention," June 18, 1996
(f) DoD 8910.1-M, "DoD Procedures for Management of Information Requirements," June 30, 1998
(g) DoD Instruction 6050.05, "DoD Hazard Communication (HAZCOM) Program," August 15, 2006
(h) Defense Logistics Agency Instruction 4145.11, Army Technical Manual 38-410, Naval Supply Publication 573, Air Force Joint Manual 23-209, and Marine Corps Order 4450.12A, "Storage and Handling of Hazardous Materials," January 13, 1999
(i) Air Force Interservice Manual 24-204(I), Army Technical Order 3 8-250, Naval Supply Publication 505, Marine Corps Order P4030.19I, and Defense Logistics Agency Instruction 4145.3, Defense Contract Management Agency D1, Ch3.4 (HM24), "Preparing Hazardous Materials for Military Air Shipments," 15 April 2007, Incorporating Change 1, 4 May 2007.
(j) DoD 4160.21 -M, "Defense Materiel Disposition Manual," August 18, 1997, authorized by DoD 4140.1-R, "Department of Defense Materiel Management Regulation," January 25, 1993
(k) DoD Directive 4001.1, "Installation Management," September 4, 1986
(l) Naval Facility Manual of Operation-213, Air Force Regulation 9 1-8, and Army Technical Manual 5-634, "Solid Waste Management," May 1990
(m) DoD 4150.7-M, "DoD Pest Management Training and Certification," April 24, 1997
(n) Military Handbook 1 028/8A, "Design of Pest Management Facilities," November 1, 1991
(o) DoD Instruction 6055.1, "DoD Safety and Occupational Health (SOH) Program," August 19, 1998
(p) DoD Instruction 6055.5, "Industrial Hygiene and Occupational Health," January 10, 1989
(q) Section 2643 of title 15, United States Code
(r) Title 40, Code of Federal Regulations, Part 763, Subpart E, "Asbestos-Containing Materials in Schools," current edition
(s) DoD Instruction 4715.8, "Environmental Remediation for DoD Activities Overseas," February 2, 1998

CHAPTER 1

OVERVIEW

1.1 PURPOSE.

The primary purpose of these Final Governing Standards (FGS) is to provide-environmental compliance criteria at United States (U.S.) Department of Defense (DOD) installations in Bahrain. This document implements DOD Instruction 4715.5, "Management of Environmental Compliance at Overseas Installations," dated 22 April 1996, and is based upon DOD 4715.05-G, "Overseas Environmental Baseline Guidance Document" (OEBGD), dated 1 May 2007.

1.2 APPLICABILITY.

1.2.1. These FGS provide environmental compliance criteria applicable to actions for DOD Components at installations located in the Kingdom of Bahrain.

1.2.2. These FGS represent minimum criteria; DOD Components may impose additional criteria provided those policies and directives do not directly conflict with these FGS.

1.2.3. Activities and installations shall notify the Environmental Executive Agent (EEA), United States Central Command (US

1.2.4. CENTCOM), via the Lead Environmental Component (LEC), Commander Navy Region Europe Africa Southwest Asia (CNREURAFSWA), of any directly conflicting DOD Component policies or directives they discover prior to imposing criteria more protective than provided in these FGS.

1.2.5. DOD Components shall not enter into agreements with Bahrain authorities at any level that establishes a criterion for environmental compliance that contradicts those provided in these FGS without the prior written approval of the LEC.

1.3. EXEMPTIONS.

These FGS do not apply to:

1.3.1. DOD installations that do not have more than *de minimis* potential to affect the natural environment (e.g., offices whose operations are primarily administrative, including defense attaché offices, security assistance offices, foreign buying offices, and other similar organizations), or for which the DOD Components exercise control only on a temporary or intermittent basis.

1.3.2. Leased, joint use, and similar facilities to the extent that the DOD does not control the instrumentality or operation that a criterion seeks to regulate.

1.3.3. Operations of U.S. military vessels or the operations of U.S. military aircraft, or off installation operational and training deployments. Off-installation operational deployments include cases of hostilities, contingency operations in hazardous areas, and when U.S. forces are

operating as part of a multi-national force not under full control of the United States. Such excepted operations and deployments shall be conducted in accordance with applicable international agreements, other DOD Directives (DODDs) and DOD Instructions (DODIs), and environmental annexes incorporated into operation plans or operation orders. However, these FGS do apply to support functions for U.S. military vessels and U.S. military aircraft provided by the DOD Components, including management or disposal of off-loaded waste or material.

1.3.4. Facilities and activities associated with the Naval Nuclear Propulsion Program, which are covered under Executive Order (E.O.) 12344 "Naval Nuclear Propulsion Program," and conducted pursuant to 42 United States Code (U.S.C.) 7158.

1.3.5. The determination or conduct of remediation to correct environmental problems caused by the Department of Defense's past activities, conducted in accordance with DOD Instruction (DODI) 4715.8, "Environmental Remediation for DOD Activities Overseas.

1.3.6. Environmental analyses conducted under E.O. 12114, "Environmental Effects Abroad of Major Federal Actions."

1.4. DEFINITIONS.

For purposes of these FGS, unless otherwise indicated, the following definitions apply:

1.4.1. Criteria and Management Practices. Particular substantive provisions of the OEBGD that are used by the EEA to develop these FGS.

1.4.2. Existing Facility. Any facility and/or building, source, or project in use or under construction before 1 October 1994, unless it is subsequently substantially modified.

1.4.3. Final Governing Standards. A comprehensive set of country-specific substantive provisions, typically technical limitations on effluent, discharges, etc., or a specific management practice.

1.4.4. New Facility. Any facility and/or building, source, or projects with a construction start date on or after 1 October 1994, or a pre-existing facility that has been substantially modified since 1 October 1994.

1.4.5. Substantial Modification. Any modification to a facility and/or building the cost of which exceeds $1 million, regardless of funding source.

1.5. ADDITIONAL INFORMATION.

1.5.1. The DOD Components shall establish and implement an environmental audit program to ensure that overseas installations assess compliance with these FGS at least once every 3 years at all major installations.

1.5.2. DODI 4715.4, "Pollution Prevention," implements policy, assigns responsibility, and prescribes procedures for implementation of pollution prevention programs throughout the

DOD. As a matter of DOD policy, DODI 4715.4 should be consulted for particular requirements that apply to activities outside the United States. Pollution prevention should be considered in developing the criteria and management practices for these FGS. Where economically advantageous and consistent with mission requirements, pollution prevention shall be the preferred means for attaining compliance with these FGS.

1.5.3. Laboratory analyses necessary to implement these FGS would normally be conducted in a laboratory that has been certified by a U.S. or Bahrain regulatory authority for the applicable test method. In the absence of a certified laboratory, analyses may also be conducted at a laboratory that has an established reliable record of QA compliance with standards for the applicable test method that are generally recognized by appropriate industry or scientific organizations, such as ISO 17025.

1.5.4. These FGS do not create any rights or obligations enforceable against the United States, the DOD, or any of its components, nor does it create any standard of care or practice for individuals. Although these FGS refers to other DODDs and DODIs, it is intended only to coordinate the requirements of those directives as required to implement the policies found in DODI 4715.5. These FGS do not change other DOD or service directives or instructions, or alter DOD or service policies.

1.6. WAIVERS.

1.6.1. If compliance with the FGS at particular installations or facilities would seriously impair operations, adversely affect relations with Bahrain authorities, or require substantial expenditure of funds at an installation that has been identified for closure or at an installation that has been identified for a realignment that would remove the requirement, a DOD Component may ask the EEA, via the LEC, to waive the particular standard. See DOD Instruction 4715.5, “Management of Environmental Compliance at Overseas Installations”, and USCENTCOM Regulation 200-1, “Protection and Enhancement of Environmental Assets,” for complete waiver procedures.

1.7. APPROVALS.

1.7.1. Approval may be required to engage in activities that have the potential to affect the environment in Bahrain. Generally, activities that occur within the confines of the installation and do not affect the environment outside of the installation do not require approval. DoD Components shall not apply for approval directly from Bahrain authorities. DoD Components shall contact the LEC to determine approval requirements and coordinate with Bahrain representatives regarding activities that may require approval as indicated in these FGS. If the installation has a Bahrain Installation Commander (BIC), the U.S. Installation Commander or designated representative shall inform the BIC of activities that may require approval, keeping the LEC informed. If the BIC declines to engage regarding an approval, DOD Components shall contact the LEC to determine approval requirements.

1.7.2. If Bahrain approval specifies a more protective standard than prescribed in the FGS, the standard in the approval shall be the compliance standard. However, if an approval allows a less protective standard, then the FGS will be the compliance standard unless a waiver is obtained (see section 1.6).

1.7.3. Contractors performing work for DOD on DOD installations must comply with all Bahrain laws and regulations including obtaining all necessary licenses and approvals. Contracting services does not absolve DOD Components from compliance with these FGS unless exempted under section 1.3, Exemptions.

1.7.4. Certificates obtained from appropriate Bahrain authorities (e.g., tank tightness testing) do not fall within the definition of an approval process requiring the LEC. Request for services (e.g., inspections) shall be forwarded directly to the appropriate organizations without involving the LEC.

1.8. WORKING WITH THE LEC.

1.8.1. DOD Components shall consult with the LEC when specified in these FGS and when:

1.8.1.1. Significant exceedances of FGS or approval criteria occur

1.8.1.2. Bahrain enforcement action is initiated

1.8.1.3. An issue is raised that has the potential to affect multiple installations or military services

1.8.2. DOD Components shall notify the LEC when specified in these FGS and when:

1.8.2.1. Information is provided to BIC for activities requiring approval governed by these FGS.

1.8.2.2. BIC or other Bahrain official requests information.

1.8.2.3. Any Bahrain official requests access to an installation in order to conduct an environmental inspection.

1.8.3. The LEC, working with the notifying DOD Component, may determine that notification specified in these FGS is no longer required on a case-by-case basis.

1.9. ACCESS TO INSTALLATIONS BY BAHRAIN AUTHORITIES. Inspections and non-routine requests for information by Bahrain authorities shall be coordinated with the BIC (if designated for a facility) or the LEC and reported to the EEA via the Component chain-of-command. To the maximum extent possible, U.S. military personnel, rather than civilian personnel, shall lead the review of DOD Component activities by Bahrain authorities during the inspection.

1.10. LEAD ENVIRONMENTAL COMPONENT.

The LEC for these FGS is the Commander, Navy Region Europe Africa Southwest Asia. Any questions or comments pertaining to these FGS shall be sent to:

Commander, Navy Region Europe Africa Southwest Asia
PSC 817 Box 108
FPO AE 09622
DSN Voice (314) 626-2886
DSN FAX (314) 626-4341
Commercial +39 081-568-2886

Or to the Environmental LEC representative in Bahrain at:

Commander Navy Region Europe Africa Southwest Asia
Detachment Bahrain
Environmental Program
PSC 451 BOX 850
FPO AE 09834-2800
DSN Voice (318) 439-4603
DSN FAX (318) 439-3028
Commercial +973-1-785-4603

CHAPTER 2

AIR EMISSIONS

2.1. SCOPE

This Chapter contains standards for air emissions sources. Criteria addressing open burning of solid waste are contained in Chapter 7, "Solid Waste." Criteria addressing asbestos are contained in Chapter 15, "Asbestos."

2.2. DEFINITIONS

2.2.1. Coal Refuse. Waste products from coal mining, cleaning, and coal preparation operations (e.g., culm and gob) contain coal, matrix material, clay, and other organic and inorganic material.

2.2.2. Cold Cleaning Machine. Any device or piece of equipment that contains and/or uses liquid solvent, into which parts are placed to remove soil and other contaminants from the surfaces of the parts or to dry the parts. Cleaning machines that contain and use heated, non-boiling solvent to clean the parts are classified as cold cleaning machines.

2.2.3. Commercial and Industrial Solid Waste Incinerator (CISWI) Units. Any combustion device that combusts commercial and industrial waste in an enclosed device using controlled flame combustion without energy recovery that is a distinct operating unit of any commercial or industrial facility (including field-erected, modular, and custom incineration units operating with starved or excess air). CISWI units do NOT include Municipal Waste Combustor Units, Sewage Sludge Incinerators, Medical Waste Incinerators, and Hazardous Waste Combustion Units.

2.2.4. Controlled Substances. Chemicals (in both mixed and pure form) listed in Table 2.2.

2.2.5. De minimis. This term means that average person would regard an issue to be so minor that it is insignificant.

2.2.5. Fossil Fuel. Natural gas, petroleum, coal, and any form of solid, liquid, or gaseous fuel derived from such material for the purpose of creating useful heat.

2.2.6. Freeboard Ratio. The ratio of the solvent cleaning machine freeboard height to the smaller interior dimension (length, width, or diameter) of the solvent cleaning machine.

2.2.7. Hanging Inhalable Particles. Naturally hanging particles resulting from sand storms, forest fires, and volcanic activities, in addition to some industrial activities. They are classified according to size. Those between 0.1µm and 10µm are classified as hanging inhalable particles.

2.2.8. Hydrofluorocarbon (HFC). A compound consisting of hydrogen, fluorine, and carbon often used as a replacement for Ozone-Depleting Substances (ODS).

C2.2.9. Incinerator. Any furnace used in the process of burning solid or liquid waste for the purpose of reducing the volume of the waste by removing combustible matter, including equipment with heat recovery systems for either hot water or steam generation.

2.2.10. Most Appropriate Available Technique. The best standards, criteria, levels, and means available to prevent or reduce pollution from projects in the country and are defined by a specialized authority.

2.2.11. Motor Vehicle. Any commercially available vehicle that is not adapted to military use that is self-propelled and designed for transporting persons or property on a street or highway, including but not limited to, passenger cars, light duty vehicles, and heavy duty vehicles.

2.2.12. Municipal Waste Combustion (MWC) Units. Any equipment that combusts solid, liquid, or gasified municipal solid waste (MSW) including, but not limited to, field-erected MWC units (with or without heat recovery), modular MWC units (starved-air or excess-air), boilers (for example, steam generating units), furnaces (whether suspension-fired, grate-fired, mass-fired, air curtain incinerators, or fluidized bed-fired), and pyrolysis/combustion units. Municipal waste combustion units do NOT include pyrolysis or MWC units located at a plastics or rubber recycling unit, cement kilns that combust MSW, internal combustion engines, gas turbines, or other combustion devices that combust landfill gases collected by landfill gas collection systems.

2.2.13. Municipal Solid Waste (MSW). Household, commercial/retail, or institutional waste. Household waste includes material discarded from residential dwellings, hotels, motels, and other similar permanent or temporary housing. Commercial/retail waste includes material discarded by stores, offices, restaurants, warehouses, non-manufacturing activities at industrial facilities, and other similar establishments or facilities. Institutional waste includes materials discarded by schools, hospitals (non-medical), non-manufacturing activities at prisons and government facilities, and other similar establishments or facilities. Household, commercial/retail, and institutional waste does include yard waste and refuse-derived fuel. Household, commercial/retail, and institutional waste does not include used oil; sewage sludge; wood pallets; construction, renovation, and demolition wastes (which include railroad ties and telephone poles); clean wood; industrial process or manufacturing wastes; medical waste; or motor vehicles (including motor vehicle parts or vehicle fluff).

2.2.14. Ozone-Depleting Substances. Those substances listed in Tables 2.2 and 2.3.

2.2.15. Pathological Waste. Waste material consisting of only human or animal remains, anatomical parts, and/or tissue, the bags/containers used to collect and transport the waste material, and animal bedding (if applicable).

2.2.16. Perfluorocarbon (PFC). A compound consisting solely of carbon and fluorine often used as a replacement for ODS.

2.2.17. Process Heater. A device that is primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst.

2.2.18. Pyrolysis. The endothermic gasification of hospital waste and/or medical/infectious waste using external energy.

2.2.19. Stack. Any point in a source covered by criteria contained in 2.3.1., 2.3.2., 2.3.3., 2.3.4., or 2.3.5. designed to emit pollutants.

2.2.20. Steam/Hot Water Generating Unit. A device that combusts any fuel and produces steam or heats water or any other heat transfer medium. This definition does not include nuclear steam generators or process heaters.

2.2.21. Substantially-Modified. Any modification to a facility/building, the cost of which exceeds 377,100 BD ($1 million), regardless of funding source.

2.2.22. Vapor Cleaning Machine. A batch or in-line solvent cleaning machine that boils liquid solvent which generates solvent vapor that is used as a part of the cleaning or drying cycle.

2.3. CRITERIA

2.3.1. Steam/Hot Water Generating Units. The following standards apply to units that commenced construction on or after 1 October 1994 or that were substantially modified since 1 October 1994.

2.3.1.1. Air Emission Standards. The following criteria apply to units with a maximum design heat input capacity $\geq$ 3.0 MW or 10 million Btu/hr.

2.3.1.1.1. Steam/hot water generating units and associated emissions controls, if applicable, must be designed to meet the emission standards for specific sized units shown in Table 2.1. at all times.

2.3.1.1.2. For units combusting liquid or solid fossil fuels, fuel sulfur content (weight %) and higher heating value will be measured and recorded for each new shipment of fuel. Document compliance with the SO_2 limits using the limits in Table 2.1. Alternatively, install a properly calibrated and maintained continuous emissions monitoring system to measure the flue gas for SO_2 and either oxygen (O_2) or carbon dioxide (CO_2). Otherwise SO_2 shall be measured using the fluorescent method, or any other internationally-approved method.

2.3.1.2. Air Emissions Monitoring. Steam/hot water generating units subject to opacity or nitrogen oxides (NO_X) standards in Table 2.1, must have a properly calibrated and maintained continuous emissions monitoring system (CEMS) to measure the flue gas as follows:

2.3.1.2.1. For units with a maximum design heat input capacity > 9 MW (30 million Btu/hr): Opacity, except that CEMS is not required where gaseous or distillate fuels are the only fuels combusted.

2.3.1.2.2. For fossil fuel fired units with a maximum design heat input capacity > 30 MW (100 million Btu/hr): NO_X and either O_2 or CO_2.

2.3.2. Incinerators. The following requirements do not apply to incinerators combusting hazardous waste or munitions. Refer to Chapter 6, "Hazardous Waste," for information regarding hazardous waste disposal and incineration.

2.3.2.1. Commercial and Industrial Solid Waste Incinerators (CISWI). All CISWI units must comply with the applicable emission standards in Table 2.4. and operating limits in Table 2.5.

2.3.2.2. Municipal Waste Combustion (MWC) Units. Each MWC unit must comply with the applicable emission standards in Table 2.4. and operating limits in Table 2.5.

2.3.2.3. Sewage Sludge Incinerators. All sewage sludge incinerators that commenced construction on or after 1 October 1994 or that were substantially modified since 1 October 1994 and that burn more than 0.907 tons per day (tpd)) of sewage sludge or more than 10% sewage sludge, must also be designed to meet a particulate emission limit of 0.65 g/kg dry sludge (1.30 lb/ton dry sludge) and an opacity limit of 20% at all times, except during periods of startup, shut down, malfunction, or when emergency conditions exist.

2.3.2.4. Medical Waste Incinerators (MWI). The following standards apply to all units. These requirements do not apply to any portable units (field deployable), pyrolysis units, or units that burn only pathological, low-level radioactive waste, or chemotherapeutic waste. Refer to Chapter 8, "Medical Waste Management," for other requirements pertaining to medical waste management.

2.3.2.4.1. All MWI must be designed and operated according to the following good combustion practices (GCP):

2.3.2.4.1.1. Unit design: dual chamber.

2.3.2.4.1.2. Minimum temperature in primary chamber: ***760-871°C*** (1400-1600°F).

2.3.2.4.1.3. Minimum temperature in secondary chamber: ***982-1204°C*** (1800-2200°F).

2.3.2.4.1.4. Minimum residence time in the secondary chamber: 2 seconds.

2.3.2.4.1.5. Incinerator operators must be trained in accordance with applicable Service requirements.

2.3.2.4.1.6. Medical waste incinerators shall operate within the emission standards listed on Tables 2.6, 2.7, and 2.8.

2.3.3. Perchloroethylene (PCE) Dry Cleaning Machines. The following requirements apply to all dry cleaning machines. Chemicals listed on Table 2.2 shall NOT be used in dry cleaning and vapor degreasing activities.

2.3.3.1. Emissions from PCE dry cleaning machines installed before 1 October 1994 that use more than ***7,571 liters*** (2,000 gallons) per year of PCE (installation wide) in dry cleaning operations, must be controlled with a refrigerated condenser, unless a carbon absorber was already installed. The temperature of the refrigerated condenser must be maintained at ***7.2°C*** (45°F) or less. Dry cleaning machines and control devices must be operated according to manufacturer recommendations.

2.3.3.2. All PCE dry cleaning systems installed on or after 1 October 1994 must be of the dry-to-dry design with emissions controlled by a refrigerated condenser. The temperature of the refrigerated condenser must be maintained at ***7.2°C*** (45°F) or less. Dry cleaning machines and control devices must be operated according to manufacturer recommendations.

2.3.4. Chromium Electroplating and Chromium Anodizing Tanks. Electroplating and anodizing tanks must comply with one of the three methods below for controlling chromium emissions. Implement one of the following methods that are most appropriate to suit local conditions:

2.3.4.1. Option 1: Limit chromium emissions in the ventilation exhaust to 0.015 milligrams per dry standard cubic meter (mg/dscm). Control devices/methods must be operated according to manufacturer recommendations.

2.3.4.2. Option 2: Use chemical tank additives to prevent surface tension of the electroplating or anodizing bath from exceeding 45 dynes per centimeter (cm) as measured by a stalagmometer or 35 dynes/cm as measured by a tensiometer. Measure the surface tension prior to the first initiation of electric current on a given day and every 4 hours thereafter.

2.3.4.3. Option 3: Limit chromium emissions to the maximum allowable mass emission rate (MAMER) calculated using the following equation: MAMER = ETSA x K x 0.015 mg/dscm, where: MAMER = the alternative emission rate for enclosed hard chromium electroplating tanks in mg/hr; ETSA = the hard chromium electroplating tank surface area in square feet (ft^2); K = a conversion factor, 425 dscm/(ft^2-hr). Option 3 is ONLY applicable to hard chrome electroplating tanks equipped with an enclosing hood and ventilated at half the rate or less than that of an open surface tank of the same surface area.

2.3.5. Halogenated Solvent Cleaning Machines. These requirements apply to all solvent cleaning machines that use solvent which contains > 5 % by weight: methylene chloride (CAS No. 75-09-2), perchloroethylene (CAS No. 127-18-4), trichloroethylene (CAS No. 79-01-6), 1,1,1-trichloroethane (CAS No. 71-55-6), chloroform (CAS No. 67-66-3), or any combination of these halogenated solvents. The use of carbon tetrachloride (CAS No. 56-23-5) in any equipment or appliance is prohibited.

2.3.5.1. All cold cleaning machines (remote reservoir and immersion tanks) must be covered when not in use. Additionally, immersion type cold cleaning machines must have either a 2.54 cm (1-inch) water layer or a freeboard ratio of at least 0.75.

2.3.5.2. All vapor cleaning machines (vapor degreasers) must incorporate design and work practices which minimize the direct release of halogenated solvent to the atmosphere.

2.3.6. Units Containing ODS. The following criteria apply to direct atmospheric emissions of ODS, hydrofluorocarbons (HFC), and perfluorocarbons (PFC) from refrigeration equipment and ODS from fire suppression equipment. With regard to equipment containing controlled substances (Table 2.2), new equipment shall be prohibited from utilizing controlled substances, while existing equipment containing controlled substances shall comply with the gradual phase-out schedule. Contact the LEC to obtain the phase-out schedule and to obtain approval for laboratory and medical equipment exemptions.

2.3.6.1. Refrigerant Recovery/Recycling. All repairs, including leak repairs or services to appliances, industrial process refrigeration units, air conditioning units, or motor vehicle air conditioners, must be performed using commercially available refrigerant recovery/recycling equipment operated by trained personnel. Refrigerant technicians shall be trained in proper recovery/recycling procedures, leak detection, safety, shipping, and disposal in accordance with recognized industry standards or Bahraini equivalent.

2.3.6.2. Refrigerant Venting Prohibition. Any class I or class II ODS, HFC, and PFC refrigerant listed in Tables 2.2 and 2.3 shall not be intentionally released in the course of maintaining, servicing, repairing, or disposing of appliances, industrial process refrigeration units, air conditioning units, or motor vehicle air conditioners. *De minimis* releases associated with good faith attempts to recycle or recover ODS, HFC, and PFC refrigerants listed in ***Table 2.3*** are not subject to this prohibition.

2.3.6.3. Refrigerant Leak Monitoring and Repair. Monitor and repair refrigeration equipment for leakage in accordance with the following criteria and repair, if found to be leaking.

2.3.6.3.1. Commercial Refrigeration Equipment. Commercial refrigeration equipment normally containing > 22.70 kg (50 pounds) of refrigerant must have leaks repaired if the appliance is leaking at a rate such that the loss of refrigerant will exceed 35 % of the total charge during a 12-month period.

2.3.6.3.2. Industrial Process Refrigeration Equipment. Industrial process refrigeration equipment normally containing > 22.70 kg (50 pounds) of refrigerant must have leaks repaired if the appliance is leaking at a rate such that the loss of refrigerant will exceed 35% of the total charge during a 12-month period.

2.3.6.3.3. Comfort Cooling Appliances. Comfort cooling appliances normally containing > 22.70 kg (50 pounds) of refrigerant and not covered by subparagraphs 2.3.6.3.1. or 2.3.6.3.2. of this chapter must have leaks repaired if the appliance is leaking at a rate such that the loss of refrigerant will exceed 15 % of the total charge during a 12-month period.

2.3.6.4. ODS Fire Suppression Agent (Halon) Venting Prohibition. Halons listed in Tables 2.2 and 2.3 shall not be intentionally released into the environment while testing, maintaining, servicing, repairing, or disposing of halon-containing equipment or using such equipment for technician training. This venting prohibition does NOT apply to the following types of releases of halons listed in Table 2.3:

2.3.6.4.1. *De minimis* releases associated with good faith attempts to recycle or recover halons (i.e., release of residual halon contained in fully discharged total flooding fire extinguishing systems).

2.3.6.4.2. Emergency releases for the legitimate purpose of fire extinguishing, explosion, or other emergency applications for which the equipment or systems were designed.

2.3.6.4.3. Releases during the testing of fire extinguishing systems if each of the following is true: systems or equipment employing suitable alternative fire extinguishing agents are not available; release of extinguishing agent is essential to demonstrate equipment functionality; failure of system or equipment would pose great risk to human safety or the environment; and a simulant agent cannot be used.

2.3.7. Motor Vehicles. These criteria apply to DoD-owned motor vehicles as defined in paragraph 2.2.11.

2.3.7.1. All imported vehicles shall have a catalytic converter or equivalent form of emission control equipment.

2.3.7.*2*. All vehicles shall be inspected every two years to ensure that no tampering with factory-installed emission control equipment (catalytic converters or equivalent) has occurred.

2.3.7.*3*. If available on the local economy, use only unleaded gasoline in vehicles that are designed for this fuel.

2.3.7.4. Particulate emissions from diesel exhaust shall not exceed a concentration of 193 mg/m^3.

2.3.8. Stack Heights. H_g is the good engineering practice stack height necessary to minimize downwash of stack emissions due to aerodynamic influences from nearby structures.

2.3.8.1. Stacks shall be designed and constructed to heights at least equal to the largest H_g calculated from either of the following two criteria:

2.3.8.1.1. $H_g = H + 1.5L$, where H is the height of the nearby structure measured from the ground level elevation at the base of the stack, and L is the lesser of height or projected width of the nearby structure(s). A structure is determined to be nearby when the stack is located within 5L of the structure envelope but not greater than 0.8 km (0.5 mile). This calculation shall be performed for each structure nearby the stack being studied to determine the greatest H_g.

2.3.8.1.2. H_g is the height demonstrated by a fluid model or a field study, which ensures that the emissions from a stack do not result in maximum ground-level concentrations of any air pollutant as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structures, or nearby terrain features at least 40 % in excess of the maximum ground-level concentrations of any air pollutant experienced in the absence of such atmospheric downwash, wakes, or eddy effects. For purposes of this paragraph, “nearby” means not greater than 0.8 km (0.5 mile), except that the portion of a terrain feature may be considered to be nearby which falls within a distance of up to 10 times the maximum height (H_t) of the feature, not to

exceed 3.2 km (2 miles) if such feature achieves a height (H_t) 0.8 km (0.5 mile) from the stack that is at least 40 % of the good engineering practice stack height determined by the formulae provided in 2.3.8.1.1. of this part or 26 meters (85 feet), whichever is greater, as measured from the ground-level elevation at the base of the stack. The height of the structure or terrain feature is measured from the ground-level elevation at the base of the stack.

2.3.9. Emissions Monitoring. The following monitoring requirements shall apply to all installations, including steam/ hot water generating units. These requirements do not apply to motor vehicles.

2.3.9.1. Air emissions monitoring shall be conducted on a quarterly basis and averaged over an 8 hour period. Monitoring can be conducted more frequently if instructed by the LEC.

2.3.9.2. Installations shall submit results of the analyses to the LEC within 15 days of conducting measurements, or as instructed by the LEC.

2.3.9.3. NOx shall be monitored through the chemiluminescent method, or through any other approved method.

2.3.9.4. Particulate matter shall be monitored through the Tapered Element Oscillating Membrane (TEOM) method, or through any other approved method.

2.3.9.5. . Installations releasing pollutants which do not conform to permissible limits may be granted a grace period of ten one month periods. Contact the LEC for grace period determination."

2.3.10. Emissions Reporting. Installations releasing air pollutant emissions to the environment shall maintain data forms for their stacks. Bahrain inspector requests to examine these forms should be coordinated through the LEC. Forms can be obtained through the LEC. Installations should also consult the LEC to determine the period of time the forms should be kept. The forms shall contain the following information:

2.3.10.1. Name of company/ owner of the source of emissions

2.3.10.2. Source of emissions

2.3.10.3. Type of pollutants released

2.3.10.4. Concentration of pollutants

2.3.10.5. Point of emissions

2.3.10.6. Temperature

2.3.10.7. Stack height

2.3.10.8. Stack diameter

2.3.10.9. Location of stack

2.3.10.10. Speed/ velocity

2.3.10.11. Rate of emission

2.3.11. Volatile Organic Compounds. Installations shall establish appropriate cleaning methods, a good maintenance system, and continual inspection and control procedures at points where vapor emissions are likely for any activities utilizing VOCs.

Table 2.1. Emission Standards for Fuel Combustion Sources

Fuel Source	Pollutants	Emission Limits (mg/Nm^3 unless otherwise specified) (for units with size 10 – 100 MMBtu/hr)[1]	Emission Limits (mg/Nm^3 unless otherwise specified) (for units with size >100MMBtu/hr)[1]
All Sources	Visible Emissions	20% Opacity	20% Opacity
	Carbon Monoxide (CO)	100	100
Oil Fuel (liquid)	Nitrogen Oxides (NO_x)	150	150
	Sulfur Dioxide (SO_2)	0.43lb/MMBtu	0.43lb/MMBtu
	Hanging Particles (PM)	100	100 for units with size <50MW or 171MMBtu/hr) 50 (for units with size equal to 50 MW or 171MMBtu/hr) 129 (for units with size >171MMBtu/hr)
Gas Fuel	Nitrogen Oxides (NO_x)	100	100
	Sulfur Dioxide (SO_2)	2.3 lb/MMBtu	2.3 lb/MMBtu
	Hydrogen Sulfide (H_2S)[2]	150ppm or $228mg/Nm^3$	150ppm or $228mg/Nm^3$
	Hanging Particles (PM)	0.1lb/MMBtu	0.1lb/MMBtu
Coal-Derived Gas Fuel	Nitrogen Oxides (NO_x)	-	645
	Hanging Particles (PM)	50	50
	Sulfur Dioxide (SO_2)	500	500
Solid Fossil Fuel	Nitrogen Oxides (NO_x)	-	852
	Sulfur Dioxide (SO_2)	1460	1460
	Hanging Particles	122	122
Other Solid Fuel	Hanging Particles	0.3 lb/MMBtu	0.2 lb/MMBtu

Notes:

1. Gases shall be under dry conditions, temperature 273K, Pressure 101.325kpa, 15% O_2 reference
2. If the % of H_2S in gas is greater than the standard, SO_2 shall be used to lower this limit.

Table 2.2. Controlled ODS in Bahrain

Groups	Common Product Name	Chemical Formula	Chemical Name Description [1]	CAS No.
Group I (CFCs)	CFC-11 (R11)	$CFCl_3$	Trichlorofluoromethane	75-69-4
	CFC-12 (R12)	CF_2Cl_2	Dichlorodifluoromethane	75-71-8
	CFC-113	$C_2F_3Cl_3$	1,1,2-Trichlorotrifluoroethane	76-13-1
	CFC-114	$C_2F_4Cl_2$	Dichlorotetrafluoroethane	76-14-2
	CFC-115	C_2F_5Cl	Monochloropentafluoroethane	76-15-3
Group II (Halons)	Halon 1211	CF_2BrCl	Bromochlorodifluoromethane	353-59-3
	Halon 1301	CF_3Br	Bromotrifluoromethane	75-63-8
	Halon 2402	$C_2F_4Br_2$	Dibromotetrafluoroethane	124-73-2
Group III Fully Halogenated Compounds	CFC-13	$CClF_3$	Chlorotrifluoromethane	75-72-9
	CFC-111	C_2Cl_5F	Pentachloro-2-fluoroethane	354-56-3
	CFC-112	$C_2Cl_4F_2$	Tetrachlorodifluoroethane	76-12-0
	CFC-211	C_3Cl_7F	Heptachlorofluoropropane	422-78-6
	CFC-212	$C_3F_2Cl_6$	Hexachlorodifluoropropane	3182-26-1
	CFC-213	$C_3Cl_5F_3$	Pentachlorotrifluoropropane	2354-06-5
	CFC-214	$C_3Cl_4F_4$	Tetrachlorotetrafluoropropane	29255-31-0
	CFC-215	$C_3Cl_3F_5$	Trichloropentafluoropropane	4259-43-2
	CFC-216	$C_3F_6Cl_2$	Dichlorohexafluoropropane	661-97-2
	CFC-217	C_3F_7Cl	Chloroheptafluoropropane	422-86-6
Group IV	-	CCl_4	Carbon Tetrachloride	56-23-5
Group V	-	CH_3Br	Methyl Bromide	74-83-9
	-	CH_3CCl_3	Methyl Chloroform	71-55-6
Group VI	-	HBFCs	Hydrobromofluorocarbons	-

Table 2.3. Additional Ozone Depleting Substances Controlled on DoD Installations

Class II			
HCFC – 21	HCFC – 133a	HCFC – 225cb	HCFC – 243
HCFC – 22	HCFC – 141b	HCFC – 226	HCFC – 244
HCFC – 31	HCFC – 142b	HCFC – 231	HCFC – 251
HCFC – 121	HCFC – 151	HCFC – 232	HCFC – 252
HCFC – 122	HCFC – 221	HCFC - 233	HCFC – 253
HCFC – 123	HCFC – 222	HCFC – 234	HCFC – 261
HCFC – 124	HCFC – 223	HCFC – 235	HCFC – 262
HCFC – 131	HCFC – 224	HCFC – 241	HCFC – 271
HCFC – 132b	HCFC – 225ca	HCFC – 242	

Table 2.4. Emission Standards for Incinerators

Pollutant	**Emission Standards[1]**				
Incinerator Type	**Existing MWC units[2]**		**MWC units that begin new construction or undergo substantial modification[2]**		**CISWI units**
Rated Capacity	**35-250 tpd**	**>250 tpd**	**35-250 tpd**	**>250tpd**	**All units**
Particulate	70 mg/dscm	27 mg/dscm	24 mg/dscm		70 mg/dscm
Opacity	10%		10%		10%
NO_x	N/A	See Note 3	500 ppmv	150 ppmv	388 ppmv
SO_2	50% reduction or 77 ppmv	75% reduction or 29 ppmv	80% reduction or 30 ppmv		20 ppmv
Dioxins/furans	125 ng/dscm	See Note 4	13 ng/dscm		0.41 ng/dscm
Cadmium	0.10 mg/dscm	0.040 mg/dscm	0.020 mg/dscm		0.004 mg/dscm
Lead	1.6 mg/dscm	0.44 mg/dscm	0.20 mg/dscm		0.04 mg/dscm
Mercury	85% reduction or 0.080 mg/dscm		85% reduction or 0.080 mg/dscm		0.47 mg/dscm
HCl	50% reduction or 250 ppmv	95% reduction or 29 ppmv	80% reduction or 30 ppmv	95% reduction or 25 ppmv	62 ppmv
Fugitive ash	5% of hourly observation period		5% of hourly observation period		N/A

Notes:

1 Emission standard concentrations (mg/dscm, ppmv) are corrected to 7% oxygen, dry basis at standard conditions. mg/dscm = milligram per dry standard cubic meter, ng = nanogram, ppm = parts per million.

2 Construction or modifications that were undertaken pursuant to existing (or previous) FGS are not subject to these requirements. These criteria are not intended to require retrofitting of MWC units.

3 NO_x limits for units rated > 250 tons/day (tpd) capacity: mass burn refractory-no limit; mass burn waterwall-205 ppmv; mass burn rotary waterwall: 250 ppmv; refuse-derived fuel combustor-250 ppmv; fluidized bed combustor-180 ppmv.

4 Dioxins/furans limits for units rated >250 tpd capacity: MWC with electrostatic precipitator (ESP)-60 ng/dscm; MWC with non-ESP-30 ng/dscm.

Table 2.5. Carbon Monoxide Operating Limits for Incinerators[1]

Incinerator Type	**Existing MWC units[2]**		**MWC units that begin new construction or undergo substantial modification[2]**		**CISWI units**
Rated Capacity	**35-250 tpd**	**>250 tpd**	**35-250 tpd**	**>250tpd**	**All units**
Fluidized bed	100 ppmv (4-hr avg)		100 ppmv (4-hr avg)		157 ppmv
Fluidized bed, mixed fuel (wood/refuse-derived fuel)	200 ppmv (24-hr avg)		200 ppmv (24-hr avg)	100 ppmv (4-hr avg)	
Mass burn rotary refractory	100 ppmv (4-hr avg)		100 ppmv (24-hr avg)		
Mass burn rotary waterfall	250 ppmv (24-hr avg)		100 ppmv (24-hr avg)		
Mass burn waterfall and refractory	100 ppmv (4-hr avg)		100 ppmv (4-hr avg)		
Mixed fuel-fired (pulverized coal/refuse-derived fuel)	150 ppmv (4-hr avg)		150 ppmv (4-hr avg)		
Modular starved-air and excess air	50 ppmv (4-hr avg)		50 ppmv (4-hr avg)		
Spreader stoker, mixed fuel-fired (coal/refuse-derived fuel)	200 ppmv (24-hr avg)		150 ppmv (24-hr avg)		
Stoker, refuse-derived fuel	200 ppmv (24-hr avg)		150 ppmv (24-hr avg)		

Notes:

1. Compliance is determined by continuous emission monitoring systems.
2. Construction or modifications that were undertaken pursuant to existing (or previous) FGS are not subject to these requirements. These criteria are not intended to require retrofitting of MWC units.

Table 2.6. Air Emission Standards for Medical Waste Incinerators with a Capacity > 1 Ton Per Hour

Pollutants	Limits (mg/m^3 unless otherwise specified)
Total Plankton particles [1]	30
Carbon Monoxide [1]	50
Carbon Dioxide [2]	300
Hydrogen Chloride [2]	30
Hydrogen Fluoride [2]	2
Nitric Oxide [2]	350
Organic Compounds[2]	20
Dioxins and Furans (In operating units with design capacity of > 50 kg/hour) [3]	1 ng TEV/m^3 Refer to Table No. 2.8
Cadmium and its compounds (referred to as Cadmium)[3]	0.1
Mercury and its compounds (referred to as Mercury) [3]	0.1
Other heavy metal and their compounds Referred to as Metal [total of each Pb (Lead) As (Arsenic), CR (Chrome)] [3]	0.1

Notes:

[1] Average daily values

[2] Measurement of emissions produced once every 6 months

[3] Measurement of emissions produced once every year

TEV means Total Equivalency Quantity (Toxic Equivalent). See Table 2.8.

Table 2.7. Air Emission Standards for Medical Waste Incinerators with a Capacity < 1 Ton Per Hour

Pollutants	Limits (mg/m^3 unless otherwise specified)
Total Plankton particles[1]	30
Carbon Monoxide[1]	50
Carbon Dioxide[2]	300
Hydrogen Chloride[2]	30
Organic Compounds[2]	20
Dioxins and Furans (In operating units with design capacity of > 50kg/hour)[3]	1 ng TEV/m^3 Refer to Table 2.8
Cadmium and its compounds (referred to as Cadmium)[3]	0.1
Mercury and its compounds (referred to as Mercury)[3]	0.1
Other heavy metal and their compounds Referred to as Metal [total of each Pb (Lead) As (Arsenic), CR (Chrome)] [3]	0.1

Notes:
[1] Average daily values
[2] Measurement of emissions produced once every 6 months
[3] Measurement of emissions produced once every year
TEV means Total Equivalency Quantity (Toxic Equivalent). See Table 2.8.

Table 2.8. Dioxins and Furans

Chemical Substance(s)	Equation Value/ Factor
2, 3, 7, 8, Tetrachlorapitrodioxin	1.0
1, 2, 3, 7, 8, Pentachlorapitrodioxin	0.5
1, 2, 3, 4, 7, 8, Hexachlorapitrodioxin	0.1
1, 2, 3, 7, 8, 9, Hexachlorapitrodioxin	0.1
1, 2, 3, 6, 7, 8, Hexachlorapitrodioxin	0.1
1, 2, 3, 4, 6, 7, 8, Heptachlorapitrodioxin	0.01
Octachlorapitrodioxin	0.001
2, 3, 7, 8, Tetrachlorapitrodioxin Furan	0.1
2, 3, 4, 7, 8, Pentachlorapitrodioxin Furan	0.5
1, 2, 3, 7, 8, Pentachlorapitrodioxin Furan	0.05
1, 2, 3, 4, 7, 8, Hexachlorapitrodioxin Furan	0.1
1, 2, 3, 7, 8, 9, Hexachlorapitrodioxin Furan	0.1
1, 2, 3, 6, 7, 8, Hexachlorapitrodioxin Furan	0.1
2, 3, 4, 6, 7, 8, Hexachlorapitrodioxin Furan	0.1
1, 2, 3, 4, 6, 7, 8, Heptachlorapitrodioxin Furan	0.01
1, 2, 3, 4, 5, 8, 9, Heptachlorapitrodioxin Furan	0.01
Octachlorapitrodioxin Furan	0.001

Notes:
TEV means Total Equivalency Quantity (Toxic Equivalent), being the sum total of the concentrations of each of the dioxin and furan compounds specified in the first column of this table multiplied by their corresponding factor specified in the second column. $TEV = \Sigma$ (TEF x Concentration) for each type of Dioxin/Furan.
TEV for all dioxins and furans shall not exceed 1ng TEV/m^3.

CHAPTER 3

DRINKING WATER

3.1. SCOPE

This Chapter contains criteria for providing potable water.

3.2. DEFINITIONS

3.2.1. Action Level. The concentration of a substance in water that establishes appropriate treatment for a water system.

3.2.2. Appropriate DoD Medical Authority. The medical professional designated by the in-theater DoD Component commander to be responsible for resolving medical issues necessary to provide safe drinking water at the DoD Component's installations.

3.2.3. Concentration/Time (CT). The product of residual disinfectant concentration, C, in milligrams per liter (mg/L) determined before or at the first customer, and the corresponding disinfectant contact time, T, in minutes. CT values appear in Tables C3.T11. through C3.T24.

3.2.4. Conventional Treatment. Water treatment, including chemical coagulation, flocculation, sedimentation, and filtration.

3.2.5. Diatomaceous Earth Filtration. A water treatment process of passing water through a precoat of diatomaceous earth deposited onto a support membrane while additional diatomaceous earth is continuously added to the feed water to maintain the permeability of the precoat, resulting in substantial particulate removal from the water.

3.2.6. Direct Filtration. Water treatment, including chemical coagulation, possibly flocculation, and filtration, but not sedimentation.

3.2.7. Disinfectant. Any oxidant, including but not limited to, chlorine, chlorine dioxide, chloramines, and ozone, intended to kill or inactivate pathogenic microorganisms in water.

3.2.8. DoD Water System. A public or non-public water system.

3.2.9. Emergency Assessment. Evaluation of the susceptibility of the water source, treatment, storage and distribution system(s) to disruption of service caused by natural disasters, accidents, and sabotage.

3.2.10. First Draw Sample. A one-liter sample of tap water that has been standing in plumbing at least six hours and is collected without flushing the tap.

3.2.11. Haloacetic Acids. The sum of the concentrations in milligrams per liter of the haloacetic acid compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid,

monobromoacetic acid, and dibromoacetic acid), rounded to two significant figures after addition.

3.2.12. Groundwater Under the Direct Influence of Surface Water (GWUDISW). Any water below the surface of the ground with significant occurrence of insects or other microorganisms, algae, or large diameter pathogens such as *Giardia lamblia*; or significant and relatively rapid shifts in water characteristics, such as turbidity, temperature, conductivity, or pH, which closely correlate to climatological or surface water conditions.

3.2.13. Lead-free. A maximum lead content of 0.2% for solder and flux, and 8.0% for pipes and fittings.

3.2.14. Lead Service Line. A service line made of lead that connects the water main to the building inlet, and any lead pigtail, gooseneck, or other fitting that is connected to such line.

3.2.15. Maximum Contaminant Level (MCL). The maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet of the ultimate user of a public water system except for turbidity for which the maximum permissible level is measured after filtration. Contaminants added to the water under circumstances controlled by the user, except those resulting from the corrosion of piping and plumbing caused by water quality, are excluded.

3.2.16. Maximum Residual Disinfectant Level (MRDL). The level of a disinfectant added for water treatment measured at the consumer's tap, which may not be exceeded without the unacceptable possibility of adverse health effects.

3.2.17. Point-of-Entry (POE) Treatment Device. A treatment device applied to the drinking water entering a facility to reduce contaminants in drinking water throughout the facility.

3.2.18. Point-of-Use (POU) Treatment Device. A treatment device applied to a tap to reduce contaminants in drinking water at that tap.

3.2.19. Potable Water. Water that has been examined and treated to meet the standards in this Chapter, and has been approved as potable by the appropriate DoD medical authority.

3.2.20. Public Water System (PWS). A system for providing piped water to the public for human consumption, if such system has at least 15 service connections or regularly serves a daily average of at least 25 individuals at least 60 days of the year. This also includes any collection, treatment, storage, and distribution facilities under control of the operator of such systems, and any collection or pretreatment storage facilities not under such control that are used primarily in connection with such systems. A PWS is either a "community water system" or a "non-community system":

3.2.20.1. Community Water System (CWS). A PWS that has at least 15 service connections used by year-round residents, or which regularly serves at least 25 year-round residents.

3.2.20.2. Non-Community Water System (NCWS). A PWS that serves the public, but does not serve the same people year-round.

3.2.20.2.1. Non-transient, Non-community Water System (NTNCWS). A PWS that supplies water to at least 25 of the same people at least six months per year, but not year round. Examples include schools, factories, office buildings, and hospitals that have their own water systems.

3.2.20.2.2. Transient, Non-Community Water System (TNCWS). A PWS that provides water to at least 25 persons (but not the same 25 persons) at least six months per year. Examples include but are not limited to gas stations, motels, and campgrounds that have their own water sources.

3.2.21. Sanitary Survey. An on-site review of the water source, facilities, equipment, operation, and maintenance of a public water system to evaluate the adequacy of such elements for producing and distributing potable water.

3.2.22. Slow Sand Filtration. Water treatment process where raw water passes through a bed of sand at a low velocity (0.37 m/hr (1.2 ft/hr)), resulting in particulate removal by physical and biological mechanisms.

3.2.23. Total Trihalomethanes. The sum of the concentration in milligrams per liter of chloroform, bromoform, dibromochloromethane, and bromodichloromethane.

3.2.24. Underground Injection. A subsurface emplacement through a bored, drilled, driven or dug well where the depth is greater than the largest surface dimension, whenever the principal function of the well is emplacement of any fluid.

3.2.25. Vulnerability Assessment. The process the commander uses to determine the susceptibility to attack from the full range of threats to the security of personnel, family members, and facilities, which provide a basis for determining antiterrorism measures that can protect personnel and assets from terrorist attacks.

3.3. CRITERIA

3.3.1. DoD water systems, regardless of whether they produce or purchase water, will:

3.3.1.1. Maintain a map/drawing of the complete potable water system.

3.3.1.2. Update the potable water system master plan at least every 5 years.

3.3.1.3. Protect all water supply aquifers (groundwater) and surface water sources from contamination by suitable placement and construction of wells, by suitable placing of the new intake (heading) to all water treatment facilities, by siting and maintaining septic systems and onsite treatment units, and by appropriate land use management on DoD installations.

3.3.1.4. Conduct sanitary surveys of the water system at least every 3 years for systems using surface water, and every 5 years for systems using groundwater, or as warranted, including review of required water quality analyses. Off-installation surveys will be coordinated with HN authorities.

3.3.1.5. Provide proper treatment for all water sources. Surface water supplies, including GWUDISW, must conform to the surface water treatment requirements set forth in Table C3.T1. Groundwater supplies, at a minimum, must be disinfected.

3.3.1.6. Maintain a continuous positive pressure of at least 137.9 kPa (20 pounds per square inch (psi)) in the water distribution system.

3.3.1.7. Perform water distribution system operation and maintenance practices consisting of:

3.3.1.7.1. Maintenance of a disinfectant residual throughout the water distribution system (except where determined unnecessary by the appropriate DoD medical authority);

3.3.1.7.2. Proper procedures for repair and replacement of mains (including disinfection and bacteriological testing);

3.3.1.7.3. An effective annual water main flushing program;

3.3.1.7.4. Proper operation and maintenance of storage tanks and reservoirs; and

3.3.1.7.5. Maintenance of distribution system appurtenances (including hydrants and valves).

3.3.1.8. Establish an effective cross connection control and backflow prevention program.

3.3.1.9. Manage underground injection on DoD installations to protect underground water supply sources. At a minimum, conduct monitoring to determine the effects of any underground injection wells on nearby groundwater supplies.

3.3.1.10. Develop and update as necessary an emergency contingency plan to ensure the provision of potable water despite interruptions from natural disasters and service interruptions. At a minimum, the plan will include:

3.3.1.10.1. Plans, procedures, and identification of equipment that can be implemented or utilized in the event of an intentional or un-intentional disruption:

3.3.1.10.2. Identification of key personnel;

3.3.1.10.3. Procedures to restore service;

3.3.1.10.4. Procedures to isolate damaged lines;

3.3.1.10.5. Identification of alternative water supplies; and

3.3.1.10.6. Installation public notification procedures.

3.3.1.11. Use only lead-free pipe, solder, flux, and fittings in the installation or repair of water systems and plumbing systems for drinking water. Provide installation public notification concerning the lead content of materials used in distribution or plumbing systems, or the corrosivity of water that has caused leaching, which indicates a potential health threat if exposed to leaded water, and remedial actions which may be taken.

3.3.1.12. Maintain records showing monthly operating reports for at least 3 years, and records of bacteriological results for not less than 5 years, and chemical results for not less than 10 years.

3.3.1.13. Document corrective actions taken to correct breaches of criteria and maintain such records for at least three years. Cross connection and backflow prevention testing and repair records should be kept for at least 10 years.

3.3.1.14. Conduct vulnerability assessments, which include, but are not limited to, a review of:

3.3.1.14.1. Pipes and constructed conveyances, physical barriers, water collection, pretreatment, treatment, storage, and distribution facilities, electronic, computer, or other automated systems utilized by the PWS;

3.3.1.14.2. Use, storage, or handling of various chemicals; and

3.3.1.14.3. Operation and maintenance of the water storage, treatment, and distribution systems.

3.3.2. Regardless of whether a DoD water system produces or purchases water, it will, by independent testing or validated supplier testing, ensure conformance with the following:

3.3.2.1. Total Coliform Bacteria Requirements

3.3.2.1.1. An installation responsible for a PWS will conduct a bacteriological monitoring program to ensure the safety of water provided for human consumption and allow evaluation with the total coliform-related MCL. The MCL is based only on the presence or absence of total coliforms. The MCL is no more than 5% positive samples per month for a system examining $\geq$ 40 samples a month, and no more than one positive sample per month when a system analyzes < 40 samples per month. Further, the MCL is exceeded whenever a routine sample is positive for fecal coliforms or *E. coli* or any repeat sample is positive for total coliforms.

3.3.2.1.2. Each system must develop a written, site-specific monitoring plan and collect routine samples according to Table 3.2., “Total Coliform Monitoring Frequency.”

3.3.2.1.3. Systems with initial samples testing positive for total coliforms will collect repeat samples as soon as possible, preferably the same day. Repeat sample locations are required at the same tap as the original sample plus an upstream and downstream sample, each within five service connections of the original tap. Any additional repeat sampling which may be required

will be performed according to the appropriate DoD medical authority. Monitoring will continue until total coliforms are no longer detected.

3.3.2.1.4. When any routine or repeat sample tests positive for total coliforms, it will be tested for fecal coliform or *E. coli*. Fecal-type testing can be foregone on a total coliform positive sample if fecal or *E. coli* is assumed to be present.

3.3.2.1.5. If a system has exceeded the MCL for total coliforms, the installation will complete the notification in subsection 3.3.3. to:

3.3.2.1.5.1. The appropriate DoD medical authority, as soon as possible, but in no case later than the end of the same day the command responsible for operating the PWS is notified of the result.

3.3.2.1.5.2. The installation public as soon as possible, but not later than 72 hours after the system is notified of the test result that an acute risk to public health may exist.

3.3.2.2. Inorganic Chemical Requirements

3.3.2.2.1. An installation responsible for a PWS will ensure that the water distributed for human consumption does not exceed applicable limitations set out in Table 3.3. Except for nitrate, nitrite, and total nitrate/nitrite, for systems monitored quarterly or more frequently, a system is out of compliance if the annual running average concentration of an inorganic chemical exceeds the MCL. For systems monitored annually or less frequently, a system is out of compliance if a single sample exceeds the MCL. For nitrate, nitrite, and total nitrate/nitrite, system compliance is determined by averaging the single sample that exceeds the MCL with its confirmation sample; if this average exceeds the MCL, the system is out of compliance.

3.3.2.2.2. Systems will be monitored for inorganic chemicals at the frequency set in Table 3.4., “Inorganics Monitoring Requirements.”

3.3.2.2.3. If a system is out of compliance, the installation will complete the notification in paragraph 3.3.3. as soon as possible. If the nitrate, nitrite, or total nitrate and nitrite MCLs are exceeded, then this is considered an acute health risk and the installation will complete the notification to:

3.3.2.2.3.1. The appropriate DoD medical authority as soon as possible, but in no case later than the end of the same day the command responsible for operating the PWS is notified of the result.

3.3.2.2.3.2. The installation public as soon as possible, but not later than 72 hours after the system is notified of the test results. If the installation is only monitoring annually on the basis of direction from the appropriate DoD medical authority, it will immediately increase monitoring in accordance with Table 3.4., "Inorganics Monitoring Requirements," until remedial actions are completed and authorities determine the system is reliable and consistent.

3.3.2.2.4. The MCL for arsenic applies to CWS and NTNCWS.

3.3.2.3. Fluoride Requirements

3.3.2.3.1. An installation commander responsible for a PWS will ensure that the fluoride content of drinking water does not exceed the MCL of 4 mg/L, as stated in Table 3.3., "Inorganic Chemical MCLs."

3.3.2.3.2. Systems will be monitored for fluoride by collecting one treated water sample annually at the entry point to the distribution system for surface water systems, and once every three years for groundwater systems. Daily monitoring is recommended for systems practicing fluoridation using the criteria in Table 3.5., "Recommended Fluoride Concentrations at Different Temperatures."

3.3.2.3.3. If any sample exceeds the MCL, the installation will complete the notification in paragraph 3.3.3. as soon as possible, but in no case later than 14 days after the violation.

3.3.2.4. Lead and Copper Requirements

3.3.2.4.1. DoD CWS and NTNCWS will comply with action levels (distinguished from the MCL) of 0.015 mg/L for lead and 1.3 mg/L for copper to determine if corrosion control treatment, public education, and removal of lead service lines, if appropriate, are required. Actions are triggered if the respective lead or copper levels are exceeded in more than 10% of all sampled taps.

3.3.2.4.2. Affected DoD systems will conduct monitoring in accordance with Table 3.6., "Monitoring Requirements for Lead and Copper Water Quality Parameters." High risk sampling sites will be targeted by conducting a materials evaluation of the distribution system. Sampling sites will be selected as stated in Table 3.6.

3.3.2.4.3. If an action level is exceeded, the installation will collect additional water quality samples specified in Table 3.6., "Monitoring Requirements for Lead and Copper Water Quality Parameters." Optimal corrosion control treatment will be pursued. If action levels are exceeded after implementation of applicable corrosion control and source water treatment, lead service lines will be replaced if the lead service lines cause the lead action level to be exceeded. The installation commander will implement an education program for installation personnel (including U.S. and host nation) within 60 days and will complete the notification in paragraph 3.3.3. as soon as possible, but in no case later than 14 days after the violation.

3.3.2.5. Synthetic Organics Requirements

3.3.2.5.1. An installation responsible for CWS and NTNCWS will ensure that synthetic organic chemicals in water distributed to people do not exceed the limitations delineated in Table 3.7., "Synthetic Organic Chemical MCLs." For systems monitored quarterly or more frequently, a system is out of compliance if the annual running average concentration of an organic chemical exceeds the MCL. For systems monitored annually or less frequently, a system is out of compliance if a single sample exceeds the MCL.

3.3.2.5.2. Systems will be monitored for synthetic organic chemicals according to the schedule stated in Table 3.8., "Synthetic Organic Chemical Monitoring Requirements."

3.3.2.5.3. If a system is out of compliance, the notification set out in paragraph 3.3.3. shall be completed as soon as possible, but in no case later than 14 days after the violation. The installation will immediately begin quarterly monitoring and will increase quarterly monitoring if the level of any contaminant is at its detection limit but less than its MCL, as noted in Table 3.8., "Synthetic Organic Chemical Monitoring Requirements," and will continue until the installation commander determines the system is back in compliance, and all necessary remedial measures have been implemented.

3.3.2.6. Disinfectant/Disinfection Byproducts (DDBP) Requirements

3.3.2.6.1. An installation responsible for a CWS and NTNCWS that adds a disinfectant (oxidant, such as chlorine, chlorine dioxide, chloramines, or ozone) to any part of its treatment process (to include the addition of disinfectant by a local water supplier) will:

3.3.2.6.1.1. Ensure that the MCL of 0.08 mg/L for total trihalomethanes (TTHM), the MCL of 0.06 mg/L for haloacetic acids (HAA5), the MCL of 1.0 mg/L for chlorite, and the MCL of 0.01 mg/L for bromate are met in drinking water.

3.3.2.6.1.2. Ensure that the maximum residual disinfectant level (MRDL) of 4.0 mg/L for chlorine, the MRDL of 4.0 mg/L (measured as combined total chlorine) for chloramines when ammonia is added during chlorination, and the MRDL of 0.8 mg/L for chlorine dioxide are met in drinking water. Operators may increase residual disinfectant levels of chlorine or chloramines (but not chlorine dioxide) in the distribution system to a level and for a time necessary to protect public health to address specific microbiological contamination problems caused by circumstances such as distribution line breaks, storm runoff events, source water contamination, or cross-connections.

3.3.2.6.2. Such systems that add a disinfectant will monitor TTHM and HAA5 in accordance with Table 3.9., "Disinfectant/Disinfection Byproducts Monitoring Requirements." Additional disinfectant and disinfection byproduct monitoring for systems that utilize chlorine dioxide, chloramines, or ozone are also included in Table 3.9.

3.3.2.6.3. For TTHM and HAA5 a system is noncompliant when the running annual average of quarterly averages of all samples taken in the distribution system, computed quarterly, exceed the MCL for TTHM, 0.080 mg/L, or the MCL for HAA5, 0.060 mg/L. Refer to Table 3.9. for chlorine, chloramine, and chlorine dioxide compliance requirements. If a system is out of compliance as described in Table 3.9., the installation will accomplish the notification requirements outlined in paragraph 3.3.3. as soon as possible, but in no case later than 14 days after the violation, and undertake remedial measures.

3.3.2.7. Radionuclide Requirements

3.3.2.7.1. An installation responsible for a CWS will test the system for conformance with the applicable radionuclide limits contained in Table 3.10., "Radionuclide MCLs and Monitoring Requirements."

3.3.2.7.2. Systems will perform radionuclide monitoring as stated in Table 3.10.

3.3.2.7.3. If the average annual MCL for gross alpha activity for radium is exceeded, the installation will complete the notification according to the procedures in paragraph 3.3.3. within 14 days. Monitoring will continue until remedial actions are completed and the average annual concentration no longer exceeds the respective MCL. Continued monitoring for gross alpha-related contamination will occur quarterly, while gross beta-related monitoring will be monthly. If any gross beta MCL is exceeded, the major radioactive components will be identified.

3.3.2.8. Surface Water Treatment Requirements. DoD water systems that use surface water sources or GWUDISW will meet the surface water treatment requirements delineated in Table 3.1. If the turbidity readings in Table 3.1. are exceeded, the installation will complete the notification in paragraph 3.3.3. as soon as possible, but in no case later than 14 days after the violation and undertake remedial action. Surface water and GWUDISW systems that make changes to their disinfection practices (e.g., change in disinfectant or application point) in order to meet DDBP requirements (3.3.2.6.), will ensure that protection from microbial pathogens is not compromised.

3.3.2.9. Non-Public Water Systems. DoD NPWSs will be monitored for total coliforms, at a minimum, and disinfectant residuals periodically.

3.3.2.10. Alternative Water Supplies. DoD installations will, if necessary, only utilize alternative water sources, including POE/POU treatment devices and bottled water supplies, which are approved by the installation commander.

3.3.2.11. Filter Backwash Requirements. To prevent microbes and other contaminants from passing through and into finished drinking water, DoD PWSs will ensure that recycled streams (i.e., recycled filter backwash water, sludge thickener supernatant, and liquids from dewatering processes) are treated by direct and conventional filtration processes. This requirement only applies to DoD PWSs that:

3.3.2.11.1. Use surface water or GWUDISW;

3.3.2.11.2. Use direct or conventional filtration processes; and

3.3.2.11.3. Recycle spent filter backwash water, sludge thickener supernatant, or liquids from dewatering processes.

3.3.3. Notification Requirements. When a DoD water system is out of compliance as set forth in the preceding criteria, the appropriate DoD medical authority and installation personnel (U.S. and host nation) will be notified. The notice will provide a clear and readily understandable explanation of the violation, any potential adverse health effects, the population at risk, the steps being taken to correct the violation, the necessity for seeking an alternative water supply, if any, and any preventive measures the consumer should take until the violation is corrected. The appropriate DoD medical authority will coordinate notification of host authorities in cases where off-installation populations are at risk.

3.3.3.1. Additional Notification Requirements. The Competent Authority shall be notified, via the LEC, regarding any waterworks to be connected to their supply system five working days prior to any connection.

3.3.4. System Operator Requirements. DoD installations will ensure that personnel are appropriately trained to operate DoD water systems.

Table 3.1. Surface Water Treatment Requirements

1. Unfiltered Systems

a. Systems which use unfiltered surface water or GUDISW will analyze the raw water for total coliforms or fecal coliforms at least weekly and for turbidity at least daily, and must continue as long as the unfiltered system is in operation. If the total coliforms and/or fecal coliforms exceed 100/100 milliliters (mL) and 20/100 mL, respectively, in excess of 10% of the samples collected in the previous 6 months, appropriate filtration must be applied. Appropriate filtration must also be applied if turbidity of the source water immediately prior to the first or only point of disinfectant application exceeds 5 Nephelometric Turbidity Units (NTU).

b. Disinfection must achieve at least 99.9% (3-log) inactivation of *Giardia lamblia* cysts and 99.99% (4-log) inactivation of viruses by meeting applicable CT values, as shown in Tables C3.T11. through C3.T24.

c. Disinfection systems must have redundant components to ensure uninterrupted disinfection during operational periods.

d. Disinfectant residual monitoring immediately after disinfection is required once every four hours that the system is in operation. Disinfectant residual measurements in the distribution system will be made at the same times as total coliforms are sampled.

e. Disinfectant residual of water entering the distribution system cannot be < 0.2 mg/L for greater than four hours.

f. Water in a distribution system with a heterotrophic bacteria concentration ≤ 500/mL measured as heterotrophic plate count is considered to have a detectable disinfectant residual for the purpose of determining compliance with the Surface Water Treatment Requirements.

g. If disinfectant residuals in the distribution system are undetected in more than 5% of monthly samples for 2 consecutive months, appropriate filtration must be implemented.

2. Filtered Systems

a. Filtered water systems will provide a combination of disinfection and filtration that achieves a total of 99.9% (3-log) removal of *Giardia lamblia* cysts and 99.99% (4-log) removal of viruses.

b. The turbidity of filtered water will be monitored at least once every four hours. The turbidity of filtered water for direct and conventional filtration systems will not exceed 0.5 NTU (1 NTU for slow sand and diatomaceous earth filters) in 95% of the analyses in a month, with a maximum of 5 NTU.

c. Disinfection must provide the remaining log-removal of *Giardia lamblia* cysts and viruses not obtained by the filtration technology applied.*

d. Disinfection residual maintenance and monitoring requirements are the same as those for unfiltered systems.

*Proper conventional treatment typically removes 2.5-log *Giardia*/ 2.0-log viruses. Proper direct filtration and diatomaceous earth filtration remove 2.0-log *Giardia*/ 1.0-log viruses. Slow sand filtration removes typically removes 2.0-log *Giardia*/ 2.0-log viruses. Less log-removal may be assumed if treatment is not properly applied.

3. SW or GWUDISW systems will provide at least 99% (2-log) removal of Cryptosporidium. A system is considered to be compliant with the Cryptosporidium removal requirements if:

a. For conventional and direct filtration systems, the turbidity level of the system's combined filter effluent water does not exceed 0.3 NTU in at least 95% of the measurements taken each month and at no time exceeds 1 NTU.

b. For slow sand and diatomaceous earth filtration plants, the turbidity level of the system's combined filter effluent water does not exceed 1 NTU in at least 95% of measurements taken each month and at no time exceeds 5 NTUs.

c. For alternative systems, the system demonstrates to the appropriate medical authority that the alternative filtration technology, in combination with disinfection treatment, consistently achieves 3-log removal and/or inactivation of Giardia lamblia cysts, 4-log removal and/or inactivation of viruses, and 2-log removal of Cryptosporidium oocysts.

d. For unfiltered systems, the system continues to meet the source water monitoring requirements noted in 1a above to remain unfiltered.

4. Individual Filter Effluent Monitoring. Conventional or direct filtration systems must continuously monitor (every 15 minutes) the individual filter turbidity for each filter used at the system. Systems with two or fewer filters may monitor combined filter effluent turbidity continuously, in lieu of individual filter turbidity monitoring. If a system exceeds 1.0 NTU in two consecutive measurements for three months in a row (for the same filter), the installation must conduct a self-assessment of the filter within 14 days. The self-assessment must include at least the following components: assessment of filter performance; development of a filter profile; identification and prioritization of factors limiting filter performance; assessment of the applicability of corrections; and preparation of a self-assessment report. If a system exceeds 2.0 NTU (in two consecutive measurements 15 minutes apart) for two months in a row, a Comprehensive Performance Evaluation (CPE) must be conducted within 90 days by a third party.

5. Covers for Finished Water Storage Facilities. Installations must physically cover all finished water reservoirs, holding tanks, or storage water facilities.

Table 3.2. Total Coliform Monitoring Frequency

Population Served	Number of Samples [1]	Population Served	Number of Samples [1]
25 to 1,000 [2]	1	59,001 to 70,000	70
1,001 to 2,500	2	70,001 to 83,000	80
2,501 to 3,300	3	83,001 to 96,000	90
3,301 to 4,100	4	96,001 to 130,000	100
4,101 to 4,900	5	130,001 to 220,000	120
4,901 to 5,800	6	220,001 to 320,000	150
5,801 to 6,700	7	320,001 to 450,000	180
6,701 to 7,600	8	450,001 to 600,000	210
7,601 to 8,500	9	600,001 to 780,000	240
8,501 to 12,900	10	780,001 to 970,000	270
12,901 to 17,200	15	970,001 to 1,230,000	300
17,201 to 21,500	20	1,230,001 to 1,520,000	330
21,501 to 25,000	25	1,520,001 to 1,850,000	360
25,001 to 33,000	30	1,850,001 to 2,270,000	390
33,001 to 41,000	40	2,270,001 to 3,020,000	420
41,001 to 50,000	50	3,020,001 to 3,960,000	450
50,001 to 59,000	60	3,960,001 or more	480

Notes:

1. Minimum Number of Routine Samples Per Month

2. A non-community water system using groundwater and serving ≤ 1,000 people may monitor once in each calendar quarter during which the system provides water provided a sanitary survey conducted within the last 5 years shows the system is supplied solely by a protected groundwater source and free of sanitary defects.

Systems that use groundwater, serve < 4,900 people, and collect samples from different sites, may collect all samples on a single day. All other systems must collect samples at regular intervals throughout the month.

Table 3.3. Inorganic Chemical MCLs

Contaminant	**MCL**	
Arsenic [1]	0.010	mg/L
Antimony [1]	0.006	mg/L
Asbestos [1]	7 million	fibers/L (longer than 10 um)
Barium	2.0	mg/L
Beryllium [1]	0.004	mg/L
Cadmium [1]	0.005	mg/L
Chromium [1]	0.1	mg/L
Cyanide [1]	0.2	mg/L (as free cyanide)
Fluoride [2]	4.0	mg/L
Mercury [1]	0.002	mg/L
Nickel [1]	0.1	mg/L
Nitrate [3]	10	mg/L (as N)
Nitrite [3]	1	mg/L (as N)
Total Nitrite and Nitrate [3]	10	mg/L (as N)
Selenium [1]	0.05	mg/L
Sodium [4]		
Thallium	0.002	mg/L

Notes:

1. MCLs apply to CWS and NTNCWS.
2. Fluoride also has a secondary MCL at 2.0 mg/L. MCL applies only to CWS.
3. MCLs apply to CWS, NTNCWS, and TNCWS.
4. No MCL established. Monitoring is required so concentration levels can be made available on request. Sodium levels shall be reported to the DoD medical authority upon receipt of analysis.

Table 3.4. Inorganics Monitoring Requirements

Contaminant	Groundwater Baseline Requirement [1]	Surface Water Baseline Requirement	Trigger That Increases Monitoring [2]	Reduced Monitoring
Arsenic	1 sample / 3 yr	Annual sample	>MCL	---
Antimony	1 sample / 3 yr	Annual sample	>MCL	---
Barium	1 sample / 3 yr	Annual sample	>MCL	---
Beryllium	1 sample / 3 yr	Annual sample	>MCL	---
Cadmium	1 sample / 3 yr	Annual sample	>MCL	---
Chromium	1 sample / 3 yr	Annual sample	>MCL	---
Cyanide	1 sample / 3 yr	Annual sample	>MCL	---
Fluoride	1 sample / 3 yr	Annual sample	>MCL	
Mercury	1 sample / 3 yr	Annual sample	>MCL	---
Nickel	1 sample / 3 yr	Annual sample	>MCL	---
Selenium	1 sample / 3 yr	Annual sample	>MCL	---
Thallium	1 sample / 3 yr	Annual sample	>MCL	---
Sodium	1 sample / 3 yr	Annual sample	---	---
Asbestos [3]	1 sample every 9 years	1 sample every 9 years	>MCL	Yes
Total Nitrate/Nitrite	Annual sample	Quarterly	>50% Nitrite MCL	---
Nitrate	Annual sample [4]	Quarterly [4]	>50% MCL [5]	Yes [6]
Nitrite	Annual sample [4]	Quarterly [4]	>50% MCL [5]	Yes [7]
Corrosivity [8]	Once	Once	---	---

Notes:

1. Samples shall be taken as follows: groundwater systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment; surface water systems shall take at least one sample at every entry point to the distribution system after any application of treatment or in the distribution system at a point which is representative of each source after the treatment.
2. Increased quarterly monitoring requires a minimum of 2 samples per quarter for groundwater systems and at least 4 samples per quarter for surface water systems.
3. Necessity for analysis is predicated upon a sanitary survey conducted by the PWS.
4. Any sampling point with an analytical value ≥ 0.5 mg/L as N, (50% of the Nitrite MCL) must begin sampling for nitrate and nitrite separately. Since nitrite readily converts to nitrate, a system can conclude that if the total nitrate/nitrite value of a sample is less than half of the nitrite MCL, then the value of nitrite in the sample would also be below half of its MCL.
5. Increased quarterly monitoring shall be undertaken for nitrate and nitrate if a sample is >50% of the MCL.
6. The appropriate DoD medical authority may reduce repeat sampling frequency for surface water systems to annually if after 1 year results are <50% of MCL.
7. The appropriate DoD medical authority may reduce repeat sampling frequency to 1 annual sample if results are 50% of MCL.
8. PWSs shall be analyzed within 1 year of the effective date of country-specific FGS to determine the corrosivity entering the distribution system. Two samples (one mid-winter and one mid-summer) will be collected at the entry point of the distribution system for systems using surface water and GWUDISW. One sample will be collected for systems using only groundwater. Corrosivity characteristics of the water shall include measurements of pH, calcium, hardness, alkalinity, temperature, total dissolved solids, and calculation of the Langelier Saturation Index.

Table 3.5. Recommended Fluoride Concentrations at Different Temperatures

Annual Average of Maximum Daily Air Temperatures (□F)	**Control Limits (mg/L)**		
	Lower	**Optimum**	**Upper**
50.0 - 53.7	0.9	1.2	1.7
53.8 - 58.3	0.8	1.1	1.5
58.4 - 63.8	0.8	1.0	1.3
63.9 - 70.6	0.7	0.9	1.2
70.7 - 79.2	0.7	0.8	1.0
79.3 - 90.5	0.6	0.7	0.8

Table 3.6. Monitoring Requirements for Lead and Copper Water Quality Parameters

Population Served	**No. of Sites for Standard Monitoring [1], [2]**	**No. of Sites for Reduced Monitoring [3]**	**No. of Sites for Water Quality Parameters [4]**
>100,000	100	50	25
10,001 - 100,000	60	30	10
3,301 - 10,000	40	20	3
501 - 3,300	20	10	2
101 - 500	10	5	1
<100	5	5	1

Notes:

1. Every 6 months for lead and copper.
2. Sampling sites shall be based on a hierarchical approach. For CWS, priority will be given to single family residences which contain copper pipe with lead solder installed after 1982, contain lead pipes, or are served by lead service lines; then, structures, including multi-family residences with the foregoing characteristics; and finally, residences and structures with copper pipe with lead solder installed before 1983. For NTNCWS, sampling sites will consist of structures that contain copper pipe with lead solder installed after 1982, contain lead pipes, and/or are served by lead service lines. First draw samples will be collected from a cold water kitchen or bathroom tap; non-residential samples will be taken at an interior tap from which water is typically drawn for consumption.
3. Annually for lead and copper if action levels are met during each of 2 consecutive 6-month monitoring periods. Any small or medium-sized system (<50,000) that meets the lead and copper action levels during three consecutive years may reduce the monitoring for lead and copper from annually to once every three years. Annual or triennial sampling will be conducted during the four warmest months of the year.
4. This monitoring must be conducted by all large systems (>50,000). Small and medium sized systems must monitor water quality parameters when action levels are exceeded. Samples will be representative of water quality throughout the distribution system and include a sample from the entry to the distribution system. Samples will be taken in duplicate for pH, alkalinity, calcium, conductivity or total dissolved solids, and water temperatures to allow a corrosivity determination (via a Langelier saturation index or other appropriate saturation index); additional parameters are orthophosphate when a phosphate inhibitor is used and silica when a silicate inhibitor is used.

Table 3.7. Synthetic Organic Chemical MCLs

Synthetic Organic Chemical	mg/L	Detection limit, mg/L
Pesticides/PCBs		
Alachlor	0.002	0.0002
Aldicarb	0.003	0.0005
Aldicarb sulfone	0.003	0.0008
Aldicarb sulfoxide	0.004	0.0005
Atrazine	0.003	0.0001
Benzo[a]pyrene	0.0002	
Carbofuran	0.04	0.0009
Chlordane	0.002	0.0002
Dalapon	0.2	
2,4-D	0.07	0.0001
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.00002
Di (2-ethylhexyl) adipate	0.4	
Di (2-ethylhexyl) phthalate	0.006	
Dinoseb	0.007	
Diquat	0.02	
Endrin	0.002	0.00002
Endothall	0.1	
Ethylene dibromide (EDB)	0.00005	0.00001
Glyphosphate	0.7	
Heptachlor	0.0004	0.00004
Heptachlorepoxide	0.0002	0.00002
Hexachlorobenzene	0.001	
Hexachlorocyclopentadiene	0.05	
Lindane	0.0002	0.00002
Methoxychlor	0.04	0.0001
Oxamyl (Vydate)	0.2	
PCBs (as decachlorobiphenyls)	0.0005	0.0001
Pentachlorophenol	0.001	0.00004
Picloram	0.5	
Simazine	0.004	
2,3,7,8-TCDD (Dioxin)	0.00000003	
Toxaphene	0.003	0.001
2,4,5-TP (Silvex)	0.05	0.0002
Volatile Organic Chemicals		
Benzene	0.005	0.0005
Carbon tetrachloride	0.005	0.0005
o-Dichlorobenzene	0.6	0.0005
cis-1,2-Dichloroethylene	0.07	0.0005
trans-1,2-Dichloroethylene	0.1	0.0005
1,1-Dichloroethylene	0.007	0.0005
1,1,1-Trichloroethane	0.20	0.0005
1,2-Dichloroethane	0.005	0.0005
Dichloromethane	0.005	
1,1,2-Trichloroethane	0.005	
1,2,4-Trichloro-benzene	0.07	
1,2-Dichloropropane	0.005	0.0005
Ethylbenzene	0.7	0.0005
Monochlorobenzene	0.1	0.0005
para-Dichlorobenzene	0.075	0.0005
Styrene	0.1	0.0005

Table 3.7. Synthetic Organic Chemical MCLs

Synthetic Organic Chemical	**mg/L**	**Detection limit, mg/L**
Tetrachloroethylene	0.005	0.0005
Trichloroethylene	0.005	0.0005
Toluene	1.0	0.0005
Vinyl chloride	0.002	0.0005
Xylene (total)	10	0.0005
Other Organics		
Acrylamide	0.05% dosed at 1 ppm [1]	
Epihydrochlorin	treatment technique 0.01% dosed at 20 ppm [1]	

Note

1. [1] Only applies when adding these polymer flocculants to the treatment process. No sampling is required; the system certifies that dosing is within specified limits.

Table 3.8. Synthetic Organic Chemical Monitoring Requirements

Contaminant	Base Requirement 1		Trigger for more monitoring [2]	Reduced monitoring
	Groundwater	Surface water		
VOCs	Quarterly	Quarterly	>0.0005 mg/L	Yes [3, 4]
Pesticides/PCBs	4 quarterly samples/3 years during most likely period for their presence		>Detection limit [5]	Yes [4, 6]

Notes:

1. Groundwater systems shall take a minimum of one sample at every entry point which is representative of each well after treatment; surface water systems will take a minimum of one sample at every entry point to the distribution system at a point which is representative of each source after treatment. For CWS, monitoring compliance is to be met within 1 year of the publishing of the OEBGD (FGS); for NTNCW, compliance is to be met within 2 years of the publishing of the OEBGD (FGS).
2. Increased monitoring requires a minimum of 2 quarterly samples for groundwater systems, and at least 4 quarterly samples for surface water systems.
3. Repeat sampling frequency may be reduced to annually after 1 year of no detection, and every 3 years after three rounds of no detection.
4. Monitoring frequency may be reduced if warranted based on a sanitary survey of the PWS.
5. Detection limits noted in Table C3.T7., or as determined by the best available testing methods.
6. Repeat sampling frequency may be reduced to the following if after one round of no detection: systems >3,300 reduce to a minimum of 2 quarterly samples in one year during each repeat compliance period, or systems <3,300 reduce to a minimum of 1 sample every 3 years.
7. Compliance is based on an annual running average for each sample point for systems monitoring quarterly or more frequently; for systems monitoring annually or less frequently, compliance is based on a single sample, unless the appropriate DoD medical authority requests a confirmation sample. A system is out of compliance if any contaminant exceeds the MCL.

Table 3.9. Disinfectant/Disinfection Byproducts Monitoring Requirements

Source Water Type	**Population Served by System**	**Analyte & Frequency of Samples**	**Number of Samples**
Surface Water (SW) or Groundwater Under the Direct Influence of Surface Water (GWUDISW)	10,000 or more	TTHM & HAA5 – Quarterly[1,2]	4[1,2,3]
SW or GWUDISW	Serving 500 to 9,999	TTHM & HAA5 - Quarterly4	1[5,6]
SW or GWUDISW	499 or less	TTHM & HAA5 - Yearly	1[7,8]
Ground Water (GW)	10,000 or more	TTHM & HAA5 - Quarterly[9]	1[10,11]
GW	9,999 or less	TTHM & HAA5 - Yearly[12]	1[13,14]
		Chlorite - Daily & Monthly[15,16,17,18]	
		Bromate - Monthly[19,20]	
		Chlorine[21,22]	
		Chloramines[23,24]	
		Chlorine Dioxide[25,26,27]	
		TOC[28]	

Notes:

1. For TTHM and HAA5, a DoD system using surface water or GWUDISW that treats its water with a chemical disinfectant must collect the number of samples listed above. One of the samples must be taken at a location in the distribution system reflecting the maximum residence time of water in the system. The remaining samples shall be taken at representative points in the distribution system.
2. To be eligible for reduced monitoring, a system must meet all of the following conditions: a) the annual average for TTHM is no more than 0.040 mg/L; b) the annual average for HAA5 is no more than 0.030 mg/L; c) at least one year of routine monitoring has been completed; and d) the annual average source water total organic carbon level is no more than 4.0 mg/L prior to treatment. Systems may then reduce monitoring of TTHM and HAA5 to one sample per treatment plant per quarter. Systems remain on the reduced schedule as long as the average of all samples taken in the year is no more than 0.060 mg/L for TTHM and 0.045 mg/L for HAA5. Systems that do not meet these levels must revert to routine monitoring the following quarter.
3. A system is noncompliant if the running annual average for any quarter exceeds the TTHM MCL, 0.080 mg/L or the HAA5 MCL, 0.060 mg/L.
4. One sample must be collected per treatment plant in the system at the point of maximum residence time in the distribution system.
5. Systems meeting the eligibility requirements in Note 2 may reduce monitoring frequency to one sample per treatment plant per year. Sample must be taken at the point of maximum residence time in the distribution system and during the month of warmest water temperature. Systems remain on the reduced schedule as long as the average of all samples taken in the year is no more than 0.060 mg/L for TTHM and 0.045 mg/L for HAA5. Systems that do not meet these levels must revert to routine (quarterly) monitoring the following quarter.
6. A system is noncompliant if the annual average of all samples taken that year exceeds the TTHM MCL, 0.080 mg/L or the HAA5 MCL, 0.060 mg/L.
7. Sample must be taken at the point of maximum residence time in the distribution system and during the month of warmest water temperature. If annual sample exceeds MCL (TTHM or HAA5) the system must increase monitoring to one sample per treatment plant per quarter at the point of maximum residence time. The system may return to routine monitoring if the annual average of quarterly samples is no more than 0.060 mg/L for TTHM and 0.045 mg/L for HAA5.

Table 3.9. Disinfectant/Disinfection Byproducts Monitoring Requirements (continued)

8. No reduced monitoring schedule is available. Noncompliance exists when the annual sample (or average of annual samples is conducted) exceeds the TTHM MCL, 0.080 mg/L or if the HHA5 concentration exceeds the MCL, 0.060 mg/L.
9. For TTHM and HAA5, a DoD system using only ground water NOT under the influence of surface water that treats its water with a chemical disinfectant must collect the number of samples listed above. Samples must be taken at a location in the distribution system reflecting the maximum residence time of water in the system.
10. System may reduce monitoring to one sample per treatment plant per year if the system meets all of the following conditions: a) the annual average for TTHM is no more than 0.040 mg/L; b) the annual average for HAA5 is no more than 0.030 mg/L; and c) at least one year of routine monitoring has been completed. Sample must be taken at the point of maximum residence time in the distribution system and during the month of warmest water temperature. Systems remain on the reduced schedule as long as the average of all samples taken in the year is no more than 0.060 mg/L for TTHM and 0.045 mg/L for HAA5. Systems that do not meet these levels must revert to routine monitoring the following quarter.
11. Noncompliance exists when the annual average of quarterly averages of all samples, compounded quarterly, exceeds the TTHM MCL, 0.080 mg/L or the HHA5 the MCL, 0.060 mg/L.
12. For TTHM and HAA5, a DoD system using only ground water NOT under the influence of surface water that treats its water with a chemical disinfectant must collect the number of samples listed above. One sample per treatment plant must be taken at a location in the distribution system reflecting the maximum residence time of water in the system and during the month of warmest water temperature. If the sample exceeds the MCL, the system must increase monitoring to quarterly.
13. System may reduce monitoring to one sample per three-year monitoring cycle if the system meets all the following conditions: a) the annual average for TTHM is no more than 0.040 mg/L; b) the annual average for HAA5 is no more than 0.030 mg/L; and c) at least one year of routine monitoring has been completed. Sample must be taken at the point of maximum residence time in the distribution system and during the month of warmest water temperature. Systems remain on the reduced schedule as long as the average of all samples taken in the year is no more than 0.060 mg/L for TTHM, and 0.045 mg/L for HAA5. Systems that do not meet these levels must revert to routine monitoring. Systems on increased monitoring may return to routine monitoring if the annual average of quarterly samples does not exceed 0.060 mg/L for TTHM and 0.045 mg/L for HAA5.
14. Noncompliance exists when the annual sample (or average of annual samples) exceeds the TTHM MCL, 0.080 mg/L or the HHA5 the MCL, 0.060 mg/L.
15. For systems using chlorine dioxide for disinfection or oxidation, daily samples are taken for chlorite at the entrance to the distribution system for chlorite. The monthly chlorite samples are collected within the distribution system, as follows: one as close as possible to the first customer, one in a location representative of average residence time, and one as close as possible to the end of the distribution system (reflects maximum residence time within the distribution system).
16. Additional monitoring is required when a daily sample exceeds the chlorite MCL, 1.0 mg/L. A three-sample set (following the monthly sample set protocol) is required to be collected the following day. Further distribution system monitoring will not be required in that month unless the chlorite concentration at the entrance to the distribution system again exceeds the MCL, 1.0 mg/L.
17. For chlorite, systems may reduce routine distribution system monitoring from monthly to quarterly if the chlorite concentration in all samples taken in the distribution system is below the MCL, 1.0 mg/L, for a period of one year and the system has not been required to conduct any additional monitoring. Daily samples must still be collected. Monthly sample set monitoring resumes when if any one daily sample exceeds the MCL, 1.0 mg/L.
18. Noncompliance for chlorite exists if the average concentration of any three-sample set (i.e., one monthly sample set from within the distribution system) exceeds the MCL, 1.0 mg/L.
19. Systems using ozone for disinfection or oxidation are required to take at least one sample per month from the entrance to the distribution system for each treatment plant in the system using ozone under normal operating conditions. Systems may reduce monitoring from monthly to once per quarter if the system demonstrates that the yearly average raw water bromide concentration is < 0.05 mg/L based upon monthly measurements for one year.
20. Noncompliance is based on a running yearly average of samples, computed quarterly, that exceeds the MCL, 0.01 mg/L.
21. Chlorine samples must be measured at the same points in the distribution system and at the same time as total coliforms. Not withstanding the MRDL, operators may increase residual chlorine levels in the distribution system to a level and for a time necessary to protect public health to address specific microbiological contamination problems.

22. Noncompliance is based on a running yearly average of monthly averages of all samples, computed quarterly, exceeds the MRDL, 4.0 mg/L.

23. Chloramine samples (as either total chlorine or combined chlorine) must be measured at the same points in the distribution system and at the same time as total coliforms. Notwithstanding the MRDL, operators may increase residual chlorine levels in the distribution system to a level and for a time necessary to protect public health to address specific microbiological contamination problems.

24. Noncompliance is based on a running yearly average of monthly averages of all samples, computed quarterly, exceeds the MRDL, 4.0 mg/L.

25. For systems using chlorine dioxide for disinfection or oxidation, samples must be taken daily at the entrance to the distribution system. If the MRDL, 0.8 mg/L, is exceeded, three additional samples must be taken the following day as follows: one as close as possible to the first customer, one in a location representative of average residence time, and one as close as possible to the end of the distribution system (reflects maximum residence time within the distribution system). Systems not using booster chlorination systems after the first customer must take three samples in the distribution system as close as possible to the first customer at intervals of not less than 6 hours.

26. If any daily sample from the distribution system exceeds the MRDL and if one or more of the three samples taken the following day from within the distribution system exceeds the MRDL, the system is in violation of the MRDL and must issue public notification in accordance with paragraph C3.3.3. If any two consecutive daily samples exceed the MRDL but none of the distribution samples exceed the MRDL, the system is in violation of the MRDL. Failure to monitor at the entrance to the distribution system on the day following exceedances of the chlorine dioxide MRDL is also an MRDL violation.

27. The MRDL for chlorine dioxide may NOT be exceeded for short periods to address specific microbiological contamination problems.

28. Systems that use conventional filtration treatment must monitor each treatment plant water source for TOC on a monthly basis. Samples must be taken from the source water prior to treatment and the treated water not later than the point of combined filter effluent turbidity monitoring. Source water alkalinity must also be monitored at the same time. Surface water and GWUDISW systems with average treated water TOC of < 2.0 mg/L for two consecutive years, or < 1.0 mg/L for one year, may reduce TOC and alkalinity to one paired sample per plant per quarter.

Table 3.10. Radionuclide MCLs and Monitoring Requirements

Contaminant	MCL
Gross Alpha[1]	15 pCi/L
Combined Radium-226 and -228	5 pCi/L
Beta Particle and Photon Radioactivity[2]	4 mrem/yr
Uranium	30 μg/L

Notes:

1. Gross alpha activity includes radium-226, but excludes radon and uranium.
2. Beta particle and photon activity is also referred to as gross beta activity from manmade radionuclides.

Monitoring Requirements:

All CWSs using ground water, surface water, or systems using both ground and surface water must sample at every point (i.e., sampling points) to the distribution system that is representative of all sources being used under normal operating conditions.

For gross alpha activity and radium-226 and radium-228, systems will be tested once every 4 years. Testing will be conducted using an annual composite of 4 consecutive quarterly samples or the average of four samples obtained at quarterly intervals at a representative point in the distribution system.

Gross alpha only may be analyzed if activity is <5 picoCuries per liter (pCi/L). Where radium-228 may be present, radium-226 and/or -228 analyses should be performed when activity is >2 pCi/L. If the average annual concentration is less than half the MCL, analysis of a single sample may be substituted for the quarterly sampling procedure. A system with two or more sources having different concentrations of radioactivity shall monitor source water in addition to water from a free-flowing tap. If the installation introduces a new water source, these contaminants will be monitored within the first year after introduction.

Table 3.11. CT Values for Inactivation of *Giardia* Cysts by Free Chlorine at 0.5°C or Lower*

Chlorine Concentration (mg/L)	pH< = 6 Log Inactivations						pH = 6.5 Log Inactivations						pH = 7.0 Log Inactivations						pH = 7.5 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	23	46	69	91	114	137	27	54	82	109	136	163	33	65	98	130	163	195	40	79	119	158	198	237
0.6	24	47	71	94	118	141	28	56	84	112	140	168	33	67	100	133	167	200	40	80	120	159	199	239
0.8	24	48	73	97	121	145	29	57	86	115	143	172	34	68	103	137	171	205	41	82	123	164	205	246
1	25	49	74	99	123	148	29	59	88	117	147	176	35	70	105	140	175	210	42	84	127	169	211	253
1.2	25	51	76	101	127	152	30	60	90	120	150	180	36	72	108	143	179	215	43	86	130	173	216	259
1.4	26	52	78	103	129	155	31	61	92	123	153	184	37	74	111	147	184	221	44	89	133	177	222	266
1.6	26	52	79	105	131	157	32	63	95	126	158	189	38	75	113	151	188	226	46	91	137	182	228	273
1.8	27	54	81	108	135	162	32	64	97	129	161	193	39	77	116	154	193	231	47	93	140	186	233	279
2	28	55	83	110	138	165	33	66	99	131	164	197	39	79	118	157	197	236	48	95	143	191	238	286
2.2	28	56	85	113	141	169	34	67	101	134	168	201	40	81	121	161	202	242	50	99	149	198	248	297
2.4	29	57	86	115	143	172	34	68	103	137	171	205	41	82	124	165	206	247	50	99	149	199	248	298
2.6	29	58	88	117	146	175	35	70	105	139	174	209	42	84	126	168	210	252	51	101	152	203	253	304
2.8	30	59	89	119	148	178	36	71	107	142	178	213	43	86	129	171	214	257	52	103	155	207	258	310
3	30	60	91	121	151	181	36	72	109	145	181	217	44	87	131	174	218	261	53	105	158	211	263	316

Chlorine Concentration (mg/L)	pH< = 8 Log Inactivations						pH = 8.5 Log Inactivations						pH = 9.0 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	46	92	139	185	231	277	55	110	165	219	274	329	65	130	195	260	325	390
0.6	48	95	143	191	238	286	57	114	171	228	285	342	68	136	204	271	339	407
0.8	49	98	148	197	246	295	59	118	177	236	295	354	70	141	211	281	352	422
1	51	101	152	203	253	304	61	122	183	243	304	365	73	146	219	291	364	437
1.2	52	104	157	209	261	313	63	125	188	251	313	376	75	150	226	301	376	451
1.4	54	107	161	214	268	321	65	129	194	258	323	387	77	155	232	309	387	464
1.6	55	110	165	219	274	329	66	132	199	265	331	397	80	159	239	318	398	477
1.8	56	113	169	225	282	338	68	136	204	271	339	407	82	163	245	326	408	489
2	58	115	173	231	288	346	70	139	209	278	348	417	83	167	250	333	417	500
2.2	59	118	177	235	294	353	71	142	213	284	355	426	85	170	256	341	426	511
2.4	60	120	181	241	301	361	73	145	218	290	363	435	87	174	261	348	435	522
2.6	61	123	184	245	307	368	74	148	222	296	370	444	89	178	267	355	444	533
2.8	63	125	188	250	313	375	75	151	226	301	377	452	91	181	272	362	453	543
3	64	127	191	255	318	382	77	153	230	307	383	460	92	184	276	368	460	552

*$CT_{99.9}$ =CT for 3 log inactivation.

Table 3.12. CT Values for Inactivation of *Giardia* Cysts by Free Chlorine at 5.0°C*

Chlorine Concentration (mg/L)	pH< = 6 Log Inactivations						pH = 6.5 Log Inactivations						pH = 7.0 Log Inactivations						pH = 7.5 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	16	32	49	65	81	97	20	39	59	78	98	117	23	46	70	93	116	139	28	55	83	111	138	166
0.6	17	33	50	67	83	100	20	40	60	80	100	120	24	48	72	95	119	143	29	57	86	114	143	171
0.8	17	34	52	69	86	103	20	41	61	81	102	122	24	49	73	97	122	146	29	58	88	117	146	175
1	18	35	53	70	88	105	21	42	63	83	104	125	25	50	75	99	124	149	30	60	90	119	149	179
1.2	18	36	54	71	89	107	21	42	64	85	106	127	25	51	76	101	127	152	31	61	92	122	153	183
1.4	18	36	55	73	91	109	22	43	65	87	108	130	26	52	78	103	129	155	31	62	94	125	156	187
1.6	19	37	56	74	93	111	22	44	66	88	110	132	26	53	79	105	132	158	32	64	96	128	160	192
1.8	19	38	57	76	95	114	23	45	68	90	113	135	27	54	81	108	135	162	33	65	98	131	163	196
2	19	39	58	77	97	116	23	46	69	92	115	138	28	55	83	110	138	165	33	67	100	133	167	200
2.2	20	39	59	79	98	118	23	47	70	93	117	140	28	56	85	113	141	169	34	68	102	136	170	204
2.4	20	40	60	80	100	120	24	48	72	95	119	143	29	57	86	115	143	172	35	70	105	139	174	209
2.6	20	41	61	81	102	122	24	49	73	97	122	146	29	58	88	117	146	175	36	71	107	142	178	213
2.8	21	41	62	83	103	124	25	49	74	99	123	148	30	59	89	119	148	178	36	72	109	145	181	217
3	21	42	63	84	105	126	25	50	76	101	126	151	30	61	91	121	152	182	37	74	111	147	184	221

Chlorine Concentration (mg/L)	pH< = 8 Log Inactivations						pH = 8.5 Log Inactivations						pH = 9.0 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	33	66	99	132	165	198	39	79	118	157	197	236	47	93	140	186	233	279
0.6	34	68	102	136	170	204	41	81	122	163	203	244	49	97	146	194	243	291
0.8	35	70	105	140	175	210	42	84	126	168	210	252	50	100	151	201	251	301
1	36	72	108	144	180	216	43	87	130	173	217	260	52	104	156	208	260	312
1.2	37	74	111	147	184	221	45	89	134	178	223	267	53	107	160	213	267	320
1.4	38	76	114	151	189	227	46	91	137	183	228	274	55	110	165	219	274	329
1.6	39	77	116	155	193	232	47	94	141	187	234	281	56	112	169	225	281	337
1.8	40	79	119	159	198	238	48	96	144	191	239	287	58	115	173	230	288	345
2	41	81	122	162	203	243	49	98	147	196	245	294	59	118	177	235	294	353
2.2	41	83	124	165	207	248	50	100	150	200	250	300	60	120	181	241	301	361
2.4	42	84	127	169	211	253	51	102	153	204	255	306	61	123	184	245	307	368
2.6	43	86	129	172	215	258	52	104	156	208	260	312	63	125	188	250	313	375
2.8	44	88	132	175	219	263	53	106	159	212	265	318	64	127	191	255	318	382
3	45	89	134	179	223	268	54	108	162	216	270	324	65	130	195	259	324	389

*$CT_{99.9}$ =CT for 3 log inactivation.

Table 3.13. CT Values for Inactivation of *Giardia* Cysts by Free Chlorine at 10°C*

Chlorine Concentration (mg/L)	pH< = 6 Log Inactivations						pH = 6.5 Log Inactivations						pH = 7.0 Log Inactivations						pH = 7.5 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	12	24	37	49	61	73	15	29	44	59	73	88	17	35	52	69	87	104	21	42	63	83	104	125
0.6	13	25	38	50	63	75	15	30	45	60	75	90	18	36	54	71	89	107	21	43	64	85	107	128
0.8	13	26	39	52	65	78	15	31	46	61	77	92	18	37	55	73	92	110	22	44	66	87	109	131
1	13	26	40	53	66	79	16	31	47	63	78	94	19	37	56	75	93	112	22	45	67	89	112	134
1.2	13	27	40	53	67	80	16	32	48	63	79	95	19	38	57	76	95	114	23	46	69	91	114	137
1.4	14	27	41	55	68	82	16	33	49	65	82	98	19	39	58	77	97	116	23	47	70	93	117	140
1.6	14	28	42	55	69	83	17	33	50	66	83	99	20	40	60	79	99	119	24	48	72	96	120	144
1.8	14	29	43	57	72	86	17	34	51	67	84	101	20	41	61	81	102	122	25	49	74	98	123	147
2	15	29	44	58	73	87	17	35	52	69	87	104	21	41	62	83	103	124	25	50	75	100	125	150
2.2	15	30	45	59	74	89	18	35	53	70	88	105	21	42	64	85	106	127	26	51	77	102	128	153
2.4	15	30	45	60	75	90	18	36	54	71	89	107	22	43	65	86	108	129	26	52	79	105	131	157
2.6	15	31	46	61	77	92	18	37	55	73	92	110	22	44	66	87	109	131	27	53	80	107	133	160
2.8	16	31	47	62	78	93	19	37	56	74	93	111	22	45	67	89	112	134	27	54	82	109	136	163
3	16	32	48	63	79	95	19	38	57	75	94	113	23	46	69	91	114	137	28	55	83	111	138	166

Chlorine Concentration (mg/L)	pH< = 8 Log Inactivations						pH = 8.5 Log Inactivations						pH = 9.0 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	25	50	75	99	124	149	30	59	89	118	148	177	35	70	105	139	174	209
0.6	26	51	77	102	128	153	31	61	92	122	153	183	36	73	109	145	182	218
0.8	26	53	79	105	132	158	32	63	95	126	158	189	38	75	113	151	188	226
1	27	54	81	108	135	162	33	65	98	130	163	195	39	78	117	156	195	234
1.2	28	55	83	111	138	166	33	67	100	133	167	200	40	80	120	160	200	240
1.4	28	57	85	113	142	170	34	69	103	137	172	206	41	82	124	165	206	247
1.6	29	58	87	116	145	174	35	70	106	141	176	211	42	84	127	169	211	253
1.8	30	60	90	119	149	179	36	72	108	143	179	215	43	86	130	173	216	259
2	30	61	91	121	152	182	37	74	111	147	184	221	44	88	133	177	221	265
2.2	31	62	93	124	155	186	38	75	113	150	188	225	45	90	136	181	226	271
2.4	32	63	95	127	158	190	38	77	115	153	192	230	46	92	138	184	230	276
2.6	32	65	97	129	162	194	39	78	117	156	195	234	47	94	141	187	234	281
2.8	33	66	99	131	164	197	40	80	120	159	199	239	48	96	144	191	239	287
3	34	67	101	134	168	201	41	81	122	162	203	243	49	97	146	195	243	292

*$CT_{99.9}$ =CT for 3 log inactivation.

Table 3.14. CT Values for Inactivation of *Giardia* Cysts by Free Chlorine at 15°C*

Chlorine Concentration (mg/L)	pH< = 6 Log Inactivations						pH = 6.5 Log Inactivations						pH = 7.0 Log Inactivations						pH = 7.5 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	8	16	25	33	41	49	10	20	30	39	49	59	12	23	35	47	58	70	14	28	42	55	69	83
0.6	8	17	25	33	42	50	10	20	30	40	50	60	12	24	36	48	60	72	14	29	43	57	72	86
0.8	9	17	26	35	43	52	10	20	31	41	51	61	12	24	37	49	61	73	15	29	44	59	73	88
1	9	18	27	35	44	53	11	21	32	42	53	63	13	25	38	50	63	75	15	30	45	60	75	90
1.2	9	18	27	36	45	54	11	21	32	43	53	64	13	25	38	51	63	76	15	31	46	61	77	92
1.4	9	18	28	37	46	55	11	22	33	43	54	65	13	26	39	52	65	78	16	31	47	63	78	94
1.6	9	19	28	37	47	56	11	22	33	44	55	66	13	26	40	53	66	79	16	32	48	64	80	96
1.8	10	19	29	38	48	57	11	23	34	45	57	68	14	27	41	54	68	81	16	33	49	65	82	98
2	10	19	29	39	48	58	12	23	35	46	58	69	14	28	42	55	69	83	17	33	50	67	83	100
2.2	10	20	30	39	49	59	12	23	35	47	58	70	14	28	43	57	71	85	17	34	51	68	85	102
2.4	10	20	30	40	50	60	12	24	36	48	60	72	14	29	43	57	72	86	18	35	53	70	88	105
2.6	10	20	31	41	51	61	12	24	37	49	61	73	15	29	44	59	73	88	18	36	54	71	89	107
2.8	10	21	31	41	52	62	12	25	37	49	62	74	15	30	45	59	74	89	18	36	55	73	91	109
3	11	21	32	42	53	63	13	25	38	51	63	76	15	30	46	61	76	91	19	37	56	74	93	111

Chlorine Concentration (mg/L)	pH< = 8 Log Inactivations						pH = 8.5 Log Inactivations						pH = 9.0 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	17	33	50	66	83	99	20	39	59	79	98	118	23	47	70	93	117	140
0.6	17	34	51	68	85	102	20	41	61	81	102	122	24	49	73	97	122	146
0.8	18	35	53	70	88	105	21	42	63	84	105	126	25	50	76	101	126	151
1	18	36	54	72	90	108	22	43	65	87	108	130	26	52	78	104	130	156
1.2	19	37	56	74	93	111	22	45	67	89	112	134	27	53	80	107	133	160
1.4	19	38	57	76	95	114	23	46	69	91	114	137	28	55	83	110	138	165
1.6	19	39	58	77	97	116	24	47	71	94	118	141	28	56	85	113	141	169
1.8	20	40	60	79	99	119	24	48	72	96	120	144	29	58	87	115	144	173
2	20	41	61	81	102	122	25	49	74	98	123	147	30	59	89	118	148	177
2.2	21	41	62	83	103	124	25	50	75	100	125	150	30	60	91	121	151	181
2.4	21	42	64	85	106	127	26	51	77	102	128	153	31	61	92	123	153	184
2.6	22	43	65	86	108	129	26	52	78	104	130	156	31	63	94	125	157	188
2.8	22	44	66	88	110	132	27	53	80	106	133	159	32	64	96	127	159	191
3	22	45	67	89	112	134	27	54	81	108	135	162	33	65	98	130	163	195

*$CT_{99.9}$ =CT for 3 log inactivation.

Table 3.15. CT Values for Inactivation of *Giardia* Cysts by Free Chlorine at 20°C*

Chlorine Concentration (mg/L)	pH< = 6 Log Inactivations						pH = 6.5 Log Inactivations						pH = 7.0 Log Inactivations						pH = 7.5 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	6	12	18	24	30	36	7	15	22	29	37	44	9	17	26	35	43	52	10	21	31	41	52	62
0.6	6	13	19	25	32	38	8	15	23	30	38	45	9	18	27	36	45	54	11	21	32	43	53	64
0.8	7	13	20	26	33	39	8	15	23	31	38	46	9	18	28	37	46	55	11	22	33	44	55	66
1	7	13	20	26	33	39	8	16	24	31	39	47	9	19	28	37	47	56	11	22	34	45	56	67
1.2	7	13	20	27	33	40	8	16	24	32	40	48	10	19	29	38	48	57	12	23	35	46	58	69
1.4	7	14	21	27	34	41	8	16	25	33	41	49	10	19	29	39	48	58	12	23	35	47	58	70
1.6	7	14	21	28	35	42	8	17	25	33	42	50	10	20	30	39	49	59	12	24	36	48	60	72
1.8	7	14	22	29	36	43	9	17	26	34	43	51	10	20	31	41	51	61	12	25	37	49	62	74
2	7	15	22	29	37	44	9	17	26	35	43	52	10	21	31	41	52	62	13	25	38	50	63	75
2.2	7	15	22	29	37	44	9	18	27	35	44	53	11	21	32	42	53	63	13	26	39	51	64	77
2.4	8	15	23	30	38	45	9	18	27	36	45	54	11	22	33	43	54	65	13	26	39	52	65	78
2.6	8	15	23	31	38	46	9	18	28	37	46	55	11	22	33	44	55	66	13	27	40	53	67	80
2.8	8	16	24	31	39	47	9	19	28	37	47	56	11	22	34	45	56	67	14	27	41	54	68	81
3	8	16	24	31	39	47	10	19	29	38	48	57	11	23	34	45	57	68	14	28	42	55	69	83

Chlorine Concentration (mg/L)	pH< = 8 Log Inactivations						pH = 8.5 Log Inactivations						pH = 9.0 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	12	25	37	49	62	74	15	30	45	59	74	89	18	35	53	70	88	105
0.6	13	26	39	51	64	77	15	31	46	61	77	92	18	36	55	73	91	109
0.8	13	26	40	53	66	79	16	32	48	63	79	95	19	38	57	75	94	113
1	14	27	41	54	68	81	16	33	49	65	82	98	20	39	59	78	98	117
1.2	14	28	42	55	69	83	17	33	50	67	83	100	20	40	60	80	100	120
1.4	14	28	43	57	71	85	17	34	52	69	86	103	21	41	62	82	103	123
1.6	15	29	44	58	73	87	18	35	53	70	88	105	21	42	63	84	105	126
1.8	15	30	45	59	74	89	18	36	54	72	90	108	22	43	65	86	108	129
2	15	30	46	61	76	91	18	37	55	73	92	110	22	44	66	88	110	132
2.2	16	31	47	62	78	93	19	38	57	75	94	113	23	45	68	90	113	135
2.4	16	32	48	63	79	95	19	38	58	77	96	115	23	46	69	92	115	138
2.6	16	32	49	65	81	97	20	39	59	78	98	117	24	47	71	94	118	141
2.8	17	33	50	66	83	99	20	40	60	79	99	119	24	48	72	95	119	143
3	17	34	51	67	84	101	20	41	61	81	102	122	24	49	73	97	122	146

*$CT_{99.9}$ =CT for 3 log inactivation.

Table 3.16. CT Values for Inactivation of *Giardia* Cysts by Free Chlorine at 25°C*

Chlorine Concentration (mg/L)	pH< = 6 Log Inactivations						pH = 6.5 Log Inactivations						pH = 7.0 Log Inactivations						pH = 7.5 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	4	8	12	16	20	24	5	10	15	19	24	29	6	12	18	23	29	35	7	14	21	28	35	42
0.6	4	8	13	17	21	25	5	10	15	20	25	30	6	12	18	24	30	36	7	14	22	29	36	43
0.8	4	9	13	17	22	26	5	10	16	21	26	31	6	12	19	25	31	37	7	15	22	29	37	44
1	4	9	13	17	22	26	5	10	16	21	26	31	6	12	19	25	31	37	8	15	23	30	38	45
1.2	5	9	14	18	23	27	5	11	16	21	27	32	6	13	19	25	32	38	8	15	23	31	38	46
1.4	5	9	14	18	23	27	6	11	17	22	28	33	7	13	20	26	33	39	8	16	24	31	39	47
1.6	5	9	14	19	23	28	6	11	17	22	28	33	7	13	20	27	33	40	8	16	24	32	40	48
1.8	5	10	15	19	24	29	6	11	17	23	28	34	7	14	21	27	34	41	8	16	25	33	41	49
2	5	10	15	19	24	29	6	12	18	23	29	35	7	14	21	27	34	41	8	17	25	33	42	50
2.2	5	10	15	20	25	30	6	12	18	23	29	35	7	14	21	28	35	42	9	17	26	34	43	51
2.4	5	10	15	20	25	30	6	12	18	24	30	36	7	14	22	29	36	43	9	17	26	35	43	52
2.6	5	10	16	21	26	31	6	12	19	25	31	37	7	15	22	29	37	44	9	18	27	35	44	53
2.8	5	10	16	21	26	31	6	12	19	25	31	37	8	15	23	30	38	45	9	18	27	36	45	54
3	5	11	16	21	27	32	6	13	19	25	32	38	8	15	23	31	38	46	9	18	28	37	46	55

Chlorine Concentration (mg/L)	pH< = 8 Log Inactivations						pH = 8.5 Log Inactivations						pH = 9.0 Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	8	17	25	33	42	50	10	20	30	39	49	59	12	23	35	47	58	70
0.6	9	17	26	34	43	51	10	20	31	41	51	61	12	24	37	49	61	73
0.8	9	18	27	35	44	53	11	21	32	42	53	63	13	25	38	50	63	75
1	9	18	27	36	45	54	11	22	33	43	54	65	13	26	39	52	65	78
1.2	9	18	28	37	46	55	11	22	34	45	56	67	13	27	40	53	67	80
1.4	10	19	29	38	48	57	12	23	35	46	58	69	14	27	41	55	68	82
1.6	10	19	29	39	48	58	12	23	35	47	58	70	14	28	42	56	70	84
1.8	10	20	30	40	50	60	12	24	36	48	60	72	14	29	43	57	72	86
2	10	20	31	41	51	61	12	25	37	49	62	74	15	29	44	59	73	88
2.2	10	21	31	41	52	62	13	25	38	50	63	75	15	30	45	60	75	90
2.4	11	21	32	42	53	63	13	26	39	51	64	77	15	31	46	61	77	92
2.6	11	22	33	43	54	65	13	26	39	52	65	78	16	31	47	63	78	94
2.8	11	22	33	44	55	66	13	27	40	53	67	80	16	32	48	64	80	96
3	11	22	34	45	56	67	14	27	41	54	68	81	16	32	49	65	81	97

*$CT_{99.9}$ =CT for 3 log inactivation.

Table 3.17. CT Values for Inactivation of Viruses by Free Chlorine

	Log Inactivation		Log Inactivation		Log Inactivation	
	2.0 pH		3.0 pH		4.0 pH	
Temperature (C)	**6-9**	**10**	**6-9**	**10**	**6-9**	**10**
0.5	6	45	9	66	12	90
5	4	30	6	44	8	60
10	3	22	4	33	6	45
15	2	15	3	22	4	30
20	1	11	2	16	3	22
25	1	7	1	11	2	15

Table 3.18. CT Values for Inactivation of *Giardia* Cysts by Chlorine Dioxide

	Temperature (C)					
Inactivation	**<=1**	**5**	**10**	**15**	**20**	**25**
0.5-log	10	4.3	4	3.2	2.5	2
1-log	21	8.7	7.7	6.3	5	3.7
1.5-log	32	13	12	10	7.5	5.5
2-log	42	17	15	13	10	7.3
2.5-log	52	22	19	16	13	9
3-log	63	26	23	19	15	11

Table 3.19. CT Values for Inactivation of Viruses by Free Chlorine Dioxide pH 6-9

	Temperature (C)					
Removal	**<=1**	**5**	**10**	**15**	**20**	**25**
2-log	8.4	5.6	4.2	2.8	2.1	1.4
3-log	25.6	17.1	12.8	8.6	6.4	4.3
4-log	50.1	33.4	25.1	16.7	12.5	8.4

Table 3.20. CT Values for Inactivation of *Giardia* Cysts by Ozone

	Temperature (C)					
Inactivation	**<=1**	**5**	**10**	**15**	**20**	**25**
0.5-log	0.48	0.32	0.23	0.16	0.12	0.08
1-log	0.97	0.63	0.48	0.32	0.24	0.16
1.5-log	1.5	0.95	0.72	0.48	0.36	0.24
2-log	1.9	1.3	0.95	0.63	0.48	0.32
2.5-log	2.4	1.6	1.2	0.79	0.60	0.40
3-log	2.9	1.9	1.43	0.95	0.72	0.48

Table 3.21. CT Values for Inactivation of Viruses by Free Ozone

	Temperature (C)					
Inactivation	**<=1**	**5**	**10**	**15**	**20**	**25**
2-log	0.9	0.6	0.5	0.3	0.25	0.15
3-log	1.4	0.9	0.8	0.5	0.4	0.25
4-log	1.8	1.2	1.0	0.6	0.5	0.3

Table 3.22. CT Values for Inactivation of *Giardia* Cysts by Chloramine pH 6-9

	Temperature (C)					
Inactivation	**<=1**	**5**	**10**	**15**	**20**	**25**
0.5-log	635	365	310	250	185	125
1-log	1,270	735	615	500	370	250
1.5-log	1,900	1,100	930	750	550	375
2-log	2,535	1,470	1,230	1,000	735	500
2.5-log	3,170	1,830	1,540	1,250	915	625
3-log	3,800	2,200	1,850	1,500	1,100	750

Table 3.23. CT Values for Inactivation of Viruses by Chloramine

	Temperature (C)					
Inactivation	**<=1**	**5**	**10**	**15**	**20**	**25**
2-log	1,243	857	643	428	321	214
3-log	2,063	1,423	1,067	712	534	356
4-log	2,883	1,988	1,491	994	746	497

Table 3.24. CT Values for Inactivation of Viruses by UV

Log Inactivation	
2.0	**3.0**
21	36

CHAPTER 4

WASTEWATER

4.1. SCOPE

This Chapter contains criteria to control and regulate discharges of wastewater into surface waters. This includes, but is not limited to, storm water runoff associated with industrial activities, domestic and industrial wastewater discharges, and pollutants from indirect dischargers.

4.2. DEFINITIONS

4.2.1. 7-day Average. The arithmetic mean of pollutant parameter values for samples collected in a period of seven consecutive days.

4.2.2. 30-day Average. The arithmetic mean of pollutant parameter values for samples collected in a period of 30 consecutive days.

4.2.3. Average Monthly Discharge Limitations. The highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month.

4.2.4. Average Weekly Discharge Limitation. The highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week.)

4.2.5. Best Management Practices (BMP). Practical practices and procedures that will minimize or eliminate the possibility of pollution being introduced into waters of the host nation.

4.2.6. Biochemical Oxygen Demand (BOD_5). The five-day measure of the dissolved oxygen used by microorganisms in the biochemical oxidation of organic matter. The pollutant parameter is biochemical oxygen demand (i.e., biodegradable organics in terms of oxygen demand).

4.2.7. Carbonaceous BOD_5 ($CBOD_5$). The five-day measure of the pollutant parameter, $CBOD_5$. This test can substitute for the BOD_5 testing which suppresses the nitrification reaction/component in the BOD_5 test.

4.2.8. Conventional Pollutants. BOD_5, total suspended solids (TSS), oil and grease, fecal coliforms, and pH.

4.2.9. Daily Discharge. The "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For

pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement (e.g., concentration) "daily discharge" is calculated as the average measurement of the pollutant over the day.

4.2.10. Direct Discharge. Any "discharge of pollutants" other than an indirect discharge.

4.2.11. Discharge of a Pollutant. Any addition of any pollutant or combination of pollutants to waters of the host nation from any "point source."

4.2.12. Domestic Wastewater Treatment System (DWTS). Any DoD or HN facility designed to treat wastewater before its discharge to waters of the host nation and in which the majority of such wastewater is made up of domestic sewage.

4.2.13. Effluent Limitation. Any restriction imposed on quantities, discharge rates, and concentrations of pollutants that are ultimately discharged from point sources into waters of the host nation.

4.2.14. Existing Source. A source in operation, or under construction, prior to 1 October 1994, unless it is subsequently substantially modified, that discharges pollutants.

4.2.15. Indirect Discharge. An introduction of pollutants in process wastewater to a DWTS.

4.2.16. Industrial Activities Associated with Storm Water. Activities that may contribute pollutants to storm water runoff or drainage during wet weather events. (See Table 4.4, “Best Management Practices.”)

4.2.17. Industrial Wastewater Treatment System (IWTS). Any DoD facility other than a DWTS designed to treat process wastewater before its discharge to waters of the host nation.

4.2.18. Interference. Any addition of any pollutant or combination of pollutant discharges that inhibits or disrupts the DWTS, its treatment processes or operations, or its sludge handling processes, use or disposal.

4.2.19. Maximum Daily Discharge Limitation. The highest allowable daily discharge based on volume as well as concentration.

4.2.20. New Source. A source built or substantially modified on or after 1 October 1994 that directly or indirectly discharges pollutants to the wastewater system.

4.2.21. Point Source. Any discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, or rolling stock; but not including vessels, aircraft, or any conveyance that merely collects natural surface flows of precipitation.

4.2.22. Pollutant. Includes, but is not limited to, the following: dredged spoil; solid waste; incinerator residue; filter backwash; sewage; garbage; sewage sludge; munitions; chemical waste;

biological material; radioactive material; heat; wrecked or discarded equipment; rock; sand; cellar dirt; and industrial, municipal, and agricultural waste discharged into water.

4.2.23. Process Wastewater. Any water which during manufacturing or processing, comes into direct contact with, or results from the production or use of, any raw material, intermediate product, finished product, by-product, or waste product.

4.2.24. Regulated Facilities. Those facilities for which criteria are established under this Chapter, such as DWTS, IWTS, or industrial discharges.

4.2.25. Storm Water. Run-off and drainage from wet weather events such as rain, snow, ice, sleet, or hail.

4.2.26. Substantial Modification. Any modification to a facility, the cost of which exceeds $1,000,000, regardless of funding source.

4.2.27. Total Suspended Solids (TSS). The pollutant parameter total filterable suspended solids.

4.2.28. Total Toxic Organics (TTO). The summation of all quantifiable values > 0.01 mg/L for the toxic organics in Table 4.2, “Components of Total Toxic Organics.”

4.2.29. Waters of the Host Nation. Surface water including the territorial seas recognized under customary international law, including:

4.2.29.1. All waters which are currently used, were used in the past, or may be susceptible to use in commerce.

4.2.29.2. Waters which are or could be used for recreation or other purposes.

4.2.29.3. Waters from which fish or shellfish are or could be taken and sold.

4.2.29.4. Waters which are used or could be used for industrial purposes by industries.

4.2.29.5. Waters including lakes, rivers, streams (including intermittent streams), sloughs, prairie potholes, or natural ponds.

4.2.29.6. Tributaries of waters identified in this definition.

4.2.29.7. Exclusions to waters of the host nation. Domestic or industrial waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of this Chapter, are not waters of the host nation. This exclusion applies only to manmade bodies of water that were neither originally waters of the host nation nor resulted from impoundment of waters of the host nation.

4.3. CRITERIA

4.3.1. Effluent Limitations for Direct Dischargers of Conventional Pollutants

4.3.1.1. All new sources of pollutants directly discharged to waters of host nations will comply with the following effluent limitations on Table 4.1.

4.3.1.2. Monitoring. Monitoring requirements apply to all regulated facilities. The monitoring frequency (including both sampling and analysis) given in Table 4.3, "Monitoring Requirements," includes all three parameters which are regulated (BOD_5, TSS, and pH). Samples shall be collected at the point of discharge to the waters of the host nation.

4.3.1.3. Recordkeeping Requirements. The following monitoring and recordkeeping requirements are BMPs and apply to all facilities. Retain records for three years.

4.3.1.3.1. The effluent, concentration, or other measurement specified for each regulated parameter.

4.3.1.3.2. The daily volume of effluent discharge from each point source.

4.3.1.3.3. Test procedures for the analysis of pollutants.

4.3.1.3.4. The date, exact place, and time of sampling and/or measurements.

4.3.1.3.5. The name of the person who performed the sampling and/or measurements.

4.3.1.3.6. The date of analysis.

4.3.1.3.7. Additional record-keeping requirements for waste treatment units. An Operations Register shall be maintained for a period of three years. In addition to the criteria above, it shall comprise of the following information, depending on the type of discharge:

4.3.1.3.7.1. Concentration of pollutants in sludge, wastes or secondary remains arising from the treatment process.

4.3.1.3.7.2. Concentrations of emissions to air arising from the treatment process .

4.3.1.3.7.3. Concentration of pollutants in industrial drainage water arising from the treatment process and released into the sea every 3 months in accordance with Table 4.1 effluent limits.

4.3.1.3.7.4. Concentration of pollutants in soil/ groundwater at the treatment unit site.

4.3.1.3.7.5. Information describing the waste/secondary remains from the treatment process including the name of both generator and carrier and the dates of receipt, treatment or disposal.

4.3.1.4. Complaint System. A system for investigating water pollution complaints from individuals or HN water pollution control authorities will be established, involving the EEA, as appropriate.

4.3.1.5. Limited Effluent Standards. If DWTS plant capacity is between 0.0 and 185.49 m^3 (0.0 and 0.049 million gallons per day (MGD)), monthly sample must comply with level for 30-day average.

4.3.2. Effluent Limitations For Non-Categorical Industrial Indirect Dischargers

4.3.2.1. Effluent Limits. The following effluent limits will apply to all discharges of pollutants to DWTSs and associated collection systems from process wastewater for which categorical standards have not been established (see subparagraphs 4.3.3.1.8., 4.3.3.1.9., and 4.3.3.1.10. for a list of categorical standards).

4.3.2.1.1. Solid or Viscous Pollutants. The discharge of solid or viscous pollutants that would result in an obstruction to the domestic wastewater treatment plant flow is prohibited.

4.3.2.1.2. Ignitability and Explosiveness

4.3.2.1.2.1. The discharge of wastewater with a closed cup flashpoint of < 60°C (140°F) is prohibited.

4.3.2.1.2.2. The discharge of waste with any of the following characteristics is prohibited:

4.3.2.1.2.2.1. A liquid solution that contains > 24% alcohol by volume and has a flash point < 60°C (140°F).

4.3.2.1.2.2.2. A non-liquid which under standard temperature and pressure can cause a fire through friction.

4.3.2.1.2.2.3. An ignitable compressed gas.

4.3.2.1.2.2.4. An oxidizer, such as peroxide.

4.3.2.1.3. Reactivity and Fume Toxicity. The discharge of any of the following wastes is prohibited:

4.3.2.1.3.1. Wastes that are normally unstable and readily undergo violent changes without detonating;

4.3.2.1.3.2. Wastes that react violently with water;

4.3.2.1.3.3. Wastes that form explosive mixtures with water or forms toxic gases or fumes when mixed with water;

4.3.2.1.3.4. Cyanide or sulfide waste that can generate potentially harmful toxic fumes, gases, or vapors;

4.3.2.1.3.5. Waste capable of detonation or explosive decomposition or reaction at standard temperature and pressure;

4.3.2.1.3.6. Wastes that contain explosives regulated by Chapter 5, “Hazardous Material”; and

4.3.2.1.3.7. Wastes that produce any toxic fumes, vapors, or gases with the potential to cause safety problems or harm to workers.

4.3.2.1.4. Corrosivity. It is prohibited to discharge pollutants with the potential to be structurally corrosive to the DWTS. In addition, no discharge of wastewater below a pH of 5.0 is allowed, unless the DWTS is specifically designed to handle that type of wastewater.

4.3.2.1.5. Oil and Grease. The discharge of the following oils that can pass through or cause interference to the DWTS is prohibited: petroleum oil, non-biodegradable cutting oil, and products of mineral oil origin.

4.3.2.1.6. Spills and Batch Discharges (slugs). Installations treating or disposing liquid hazardous wastes shall prepare an emergency plan (Section 4.3.8.). Activities or installations that have a significant potential for spills or batch discharges will develop a slug prevention plan. Each plan must contain the following minimum requirements:

4.3.2.1.6.1. Description of discharge practices, including non-routine batch discharges;

4.3.2.1.6.2. Description of stored chemicals;

4.3.2.1.6.3. Plan for immediately notifying the DWTS of slug discharges and discharges that would violate prohibitions under this Chapter, including procedures for subsequent written notification within five days;

4.3.2.1.6.4. Necessary practices to prevent accidental spills. This would include proper inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site runoff, and worker training;

4.3.2.1.6.5. Proper procedures for building containment structures or equipment;

4.3.2.1.6.6. Necessary measures to control toxic organic pollutants and solvents; and

4.3.2.1.6.7. Proper procedures and equipment for emergency response, and any subsequent plans necessary to limit damage suffered by the treatment plant or the environment.

4.3.2.1.7. Trucked and Hauled Waste. The discharge of trucked and hauled waste into the DWTS, except at locations specified by the DWTS operator, is prohibited. Approval is required for the transport and disposal of hazardous waste (see Chapter 6, "Hazardous Waste"). Disposal of hazardous waste/ sludge into sewers, sea or soil is prohibited.

4.3.2.1.8. Heat. Heat in amounts that inhibit biological activity in the DWTS resulting in interference, but in no case in such quantities that the temperature of the process water at the DWTS exceeds 40°C (104°F).

4.3.2.2. Complaint System. A system for investigating water pollution complaints from HN water pollution control authorities will be established, involving the EEA as appropriate.

4.3.3. Effluent Limitations for Categorical Industrial Dischargers (Direct or Indirect). Any installations which have activities that fall into any of the industrial categories listed below must comply with the following effluent limitations (i.e., either direct or indirect discharge limitations at the source of the discharge). For most categories, the effluent limitations are the same for new and existing activities. Where differences in limitations exist, activities constructed or substantially modified on or after 1 October 1994 will meet the limitations for new activities.

4.3.3.1. Electroplating. The following discharge standards apply to electroplating operations in which metal is electroplated on any basis material and to related metal finishing operations as set forth in the various subparts. These standards apply whether such operations are conducted in conjunction with electroplating, independently, or as part of some other operation. Electroplating subparts are identified as follows:

4.3.3.1.1. Electroplating of Common Metals. Discharges of pollutants in process waters resulting from the process in which a material is electroplated with copper, nickel, chromium, zinc, tin, lead, cadmium, iron, aluminum, or any combination thereof.

4.3.3.1.2. Electroplating of Precious Metals. Discharges of pollutants in process waters resulting from the process in which a material is plated with gold, silver, iridium, palladium, platinum, rhodium, ruthenium, or any combination thereof.

4.3.3.1.3. Anodizing. Discharges of pollutants in process waters resulting from the anodizing of ferrous and nonferrous materials.

4.3.3.1.4. Metal Coatings. Discharges of pollutants in process waters resulting from the chromating, phosphating, or immersion plating on ferrous and nonferrous materials.

4.3.3.1.5. Chemical Etching and Milling. Discharges of pollutants in process waters resulting from the chemical milling or etching of ferrous and nonferrous materials.

4.3.3.1.6. Electroless Plating. Discharges of pollutants in process waters resulting from the electroless plating of a metallic layer on a metallic or nonmetallic substrate.

4.3.3.1.7. Printed Circuit Board Manufacturing. Discharges of pollutants in process waters resulting from the manufacture of printed circuit boards, including all manufacturing operations required or used to convert an insulating substrate to a finished printed circuit board.

4.3.3.1.8. The following discharge standards apply to new and existing facilities in the above electroplating subparts which directly or indirectly discharge < 38,000 liters per day (10,000 gallons per day):

Pollutant	Daily Maximum (mg/L)	4-day Average (mg/L)
Cyanide, amenable	5.0	2.7
Lead	0.6	0.4
Cadmium	1.2	0.7
Total Toxic Organics	4.57	---

4.3.3.1.9. The following discharge standards apply to new and existing facilities in the above electroplating subparts that directly, or indirectly, discharge 38,000 liters per day (10,000 gallons per day) or more:

Pollutant	Daily Maximum (mg/L)	4-day Average (mg/L)
Cyanide, total	1.9	1.0
Copper	4.5	2.7
Nickel	4.1	2.6
Chrome	7.0	4.0
Zinc	4.2	2.6
Lead	0.6	0.4
Cadmium	1.2	0.7
Total Metals	10.5	6.8
Total Toxic Organics	2.13	---

4.3.3.1.10. In addition to the above standards, new and existing facilities that electroplate precious metals and that directly or indirectly discharge 38,000 liters per day (10,000 gallons per day) or more must comply with the following standard:

Pollutant	Daily Maximum (mg/L)	4-day Average (mg/L)
Silver	1.2	0.7

4.3.3.2. Monitoring. Monitoring of categorical industrial dischargers (including both sampling and analysis) will be accomplished quarterly and will include all parameters that are specified in the paragraph of this Chapter dealing with industrial dischargers. Samples should be collected at the point of discharge prior to any mixing with the receiving water. Sampling for TTO may not be required if the commanding officer determines that no discharge of concentrated toxic organics into the wastewater has occurred and the facility has implemented a TTO management plan. (See Table 4.3, “Monitoring Requirements.”)

4.3.4. Storm Water Management

4.3.4.1. Develop and implement storm water pollution prevention (P2) plans (SWPPP) for activities listed in Table 4.4, “Best Management Practices.” Update the SWPPP annually using in-house resources.

4.3.4.2. Employee Training. Personnel who handle hazardous substances or perform activities that could contribute pollution in wet weather events should be trained in appropriate BMPs. Such training should stress P2 principles and awareness of possible pollution sources, including non-traditional sources such as sediment, nitrates, pesticides, and fertilizers.

4.3.5. Septic System. Discharge to a septic system of wastewater containing industrial pollutants in levels that will inhibit biological activity is prohibited. Known discharges of industrial pollutants to existing septic systems shall be eliminated, and appropriate actions should be taken to eliminate contamination. Siting of such systems is addressed in Chapter 3, “Drinking Water.”

4.3.6. Sludge Disposal. All sludge produced during the treatment of wastewater will be disposed in accordance with the guidance under Chapter 6, “Hazardous Waste” or Chapter 7, “Solid Waste,” as appropriate. In particular, installations shall note that:

4.3.6.1. Sludge resulting from the treatment processes described in Table 6.1 through Tables 6.12 of Chapter 6, “Hazardous Wastes” shall be disposed of as hazardous waste.

4.3.6.2. Disposal of sludge arising from the cleaning of transport vehicle tanks to sewers, soil or sea is prohibited.

Table 4.1. Monthly Average and Maximum Discharge Standards to Receiving Waters

Parameter	**Monthly Average[1] (mg/l unless otherwise specified)**	**Maximum Value (mg/l unless otherwise specified)**
Physiochemical		
Floating particles (no units)	Nil	-
pH (no units)	6-9	-
Total Suspended Solids	20	35
Temperature (°C)	(ΔT) ± 3	-
Turbidity (NTU)	25	75
Biochemical		
Biochemical Oxygen Demand	25	50
Chemical Oxygen Demand	150	350
Total Organic Carbon	50	-
Total Kjeldahl Nitrogen	5	10
Oil & Grease	8	15
Fluorescent Petroleum Matter	0.1	0.1
Phenols	0.5	1
Chemical		
Ammoniacal Nitrogen (as N)	1	3
Residual Chlorine	0.5	2
Total Cyanide (CN)	0.05	0.1
Nitrite (NO_2/N)	-	10
Nitrate (NO_3/N)	-	1
Sulfide	0.5	1
Total Phosphate (P)	1	2
Arsenic	0.1	0.5
Cadmium	0.01	0.05
Chromium total	0.1	1
Copper	0.2	0.5
Lead	0.2	1
Mercury	0.001	0.005
Nickel	0.2	0.5
Aluminum	15	25
Iron	5	10
Zinc	2	5
Biological		
Total Coliform (MPN/100ml)	1000	1000

Notes:

[1] Average reading during 30 days.

[2] Maximum values must not be exceeded at any time

Table 4.2. Components of Total Toxic Organics

Volatile Organics	
Acrolein (Propenyl)	Bromodichloromethane
Acrylonitrile	1,1,2,2-Tetrachloroethane
Methyl chloride (chloromethane)	1,2-Dichloropropane
Methyl bromide (bromomethane)	1,3-Dichloropropylene (1,3-Dichloropropene)
Vinyl Chloride (chloroethylene)	Trichloroethene
Chloroethane	Dibromochloromethane
Methylene Chloride (9 dichloromethane)	1,1,2-Trichloroethane
1,1-Dichloroethene	Benzene
1,1-Dichloroethane	2-Chloroethyl vinyl ether (mixed)
1,2-Dichloroethane	Bromoform (tribromomethane)
1,2-trans-Dichloroethene	Tetrachloroethene
Chloroform (trichloromethane)	Toluene
1,1,1-Trichloroethane	Chlorobenzene
Carbon Tetrachloride (tetrachloromethane)	Ethylbenzene
Base/Neutral Extractable Organics	
N-nitrosodimethylamine	Diethyl phthalate
bis (2-chloroethyl) ether	1,2-Diphenylhydrazine
1,3-Dichlorobenzene	N-nitrosodiphenylamine
1,4-Dichlorobenzene	4-Bromophenyl phenyl ether
1,2-Dichlorobenzene	Hexachlorobenzene
bis(2-chloroisopropyl)-ether	Phenanthrene
Hexachloroethane	Anthracene
N-nitrosodi-n-propylamine	Di-n-butyl phthalate
Nitrobenzene	Fluoranthene
Isophorone	Pyrene
bis (2-chloroethoxy) methane	Benzidine
1,2,4-trichlorobenzene	Butyl benzyl phthalate
Naphthalene	1,2-benzoanthracene (benzo (a) anthracene)
Hexachlorobutadiene	Chrysene
Hexachlorocyclopentadiene	3,3-Dichlorobenzidine
2-Chloronaphthalene	bis (2-ethylhexyl) phthalate
Acenaphthylene	Di-n-octyl phthalate
Dimethyl Phthalate	3,4-Benzofluoranthene (benzo (b) fluoranthene)
2,6-Dinitrotoluene	11,12-Benzofluoranthene (benzo (k) fluoranthene)
Acenaphthene	Benzo (a) pyrene (3,4-benzopyrene)
2,4-Dinitrotoluene	Indeno (1,2,3-cd) pyrene (2,3-o-phenylene pyrene)
Fluorene	1,2,5,6-Dibenzanthracene (dibenezo (a,h) anthracene)
4-Chlorophenyl phenyl ether	1,12-Benzoperylene (benzo (g,h,i) perylene)
Acid Extractables Organics	
2-Chlorophenol	2,4,6-Trichlorphenol
Phenol	2,4-Dinitrophenol
2-Nitrophenol	4-Nitrophenol
2,4-Dimethylphenol	p-Chloro-m-cresol
2,4-Dichlorophenol	Pentachlorophenol
4,6-Dinitro-o-cresol	
Pesticides/PCBs	
Alpha-Endosulfan	Endrin
Beta-Endosulfan	Endrin aldehyde
Endosulfan sulfate	Heptachlor

Table 4.2. Components of Total Toxic Organics

Alpha-BHC	Heptachlor Epoxide (BHC-hexachlorocyclohexane)
Beta-BHC	Toxaphene
Delta-BHC	PCB-1242 (Arochlor 1242)
Gamma-BHC	PCB-1254 (Arochlor 1254)
4,4-DDT	PCB-1221 (Arochlor 1221)
4,4-DDE (p,p-DDX)	PCB-1232 (Arochlor 1232)
(p,p-TDE)	PCB-1248 (Arochlor 1248)
Aldrin	PCB-1260 (Arochlor 1260)
Chlordane (technical mixture and metabolites)	PCB-1016 (Arochlor 1016)
Dieldrin	

Table 4.3. Monitoring Requirements

Plant Capacity (MGD)	**Monitoring Frequency**
0.001 - 0.99	Monthly
1.0 - 4.99	Weekly
> 5.0	Daily

Table 4.4. Best Management Practices

Activity	**Best Management Practice**
Aircraft Ground Support Equipment Maintenance	Perform maintenance/repair activities inside Use drip pans to capture drained fluids Cap hoses to prevent drips and spills
Aircraft/runway deicing	Perform anti-icing before the storm Put critical aircraft in hangars/shelters
Aircraft/vehicle fueling operations	Protect fueling areas from the rain Provide spill response equipment at fueling station
Aircraft/vehicle maintenance & repair	Perform maintenance/repair activities inside Use drip pans to capture drained fluids
Aircraft/vehicle washing	Capture wash water and send to wastewater treatment plant Treat wash water with oil water separator before discharge
Bulk fuel storage areas	Use dry camlock connectors to reduce fuel loss Capture spills with drip pans when breaking connections Curb fuel transfer areas, treat with oil water separator
Construction activities	Construct sediment dams/silt fences around construction sites
Corrosion control activities	Capture solvent/soaps used to prepare aircraft for painting Perform corrosion control activities inside
Hazardous material storage	Store hazardous materials inside or under cover Reduce use of hazardous materials
Outdoor material storage areas	Cover and curb salt, coal, urea piles Store product drums inside or under cover Reduce quantity of material stored outside
Outdoor painting/depainting operations	Capture sandblasting media for proper disposal Capture paint clean up materials (thinners, rinsates)
Pesticide operations	Capture rinse water when mixing chemicals Store spray equipment inside
Power production	Capture leaks and spills from power production equipment using drip pans, etc.
Vehicle storage yards	Check vehicles in storage for leaks and spills Use drip pans to capture leaking fluids

CHAPTER 5

HAZARDOUS MATERIAL

5.1. SCOPE

This Chapter contains criteria for the storage, handling, and disposition of hazardous materials. It does not cover solid or hazardous waste, underground storage tanks, petroleum storage, and related spill contingency and emergency response requirements, which are covered under other Chapters. This Guide does not cover munitions.

5.2. DEFINITIONS

5.2.1. Hazardous Chemical Warning Label. A label, tag, or marking on a container that provides the following information:

5.2.1.1. Identification/name of hazardous chemicals;

5.2.1.2. Appropriate hazard warnings; and

5.2.1.3. The name and address of the manufacturer, importer, or other responsible party; and that is prepared in accordance with DoDI 6050.05 (DoD Hazard Communication (HAZCOM) Program).

5.2.2. Hazardous Material. Any material that is capable of posing an unreasonable risk to health, safety, or the environment if improperly handled, stored, issued, transported, labeled, or disposed because it displays a characteristic listed in Table 5.1., “Typical Hazardous Materials Characteristics,” or the material is listed in Table AP1.4., “List of Hazardous Waste/Substances/Materials.” Munitions are excluded.

5.2.2.1. Classification of hazardous material is in accordance with the following hazard classes:

5.2.2.1.1. Explosives (Class 1)

5.2.2.1.2. Compressed or Liquefied Gases (Class 2)

5.2.2.1.3. Flammable Liquids (Class 3)

5.2.2.1.4. Flammable Solids (Class 4)

5.2.2.1.5. Oxidizing Agents (Class 5)

5.2.2.1.6. Toxic Materials (Class 6)

5.2.2.1.7. Radioactive Materials (Class 7)

5.2.2.1.8. Corrosive Materials (Class 8)

5.2.3. Hazardous Material Information Resource System (HMIRS). The computer-based information system developed to accumulate, maintain and disseminate important information on hazardous material used by the Department of Defense in accordance with DoDI 6050.05, "DoD Hazard Communication (HAZCOM) Program."

5.2.4. Hazardous Material Shipment. Any movement of hazardous material in a DoD land vehicle, either from an installation to a final destination off the installation, or from a point of origin off the installation to a final destination on the installation, in which certification of the shipment is involved.

5.2.5. Material Safety Data Sheet (MSDS). A form prepared by manufacturers or importers of chemical products to communicate to users the chemical and physical properties and the hazardous effects of a particular product.

5.3. CRITERIA

5.3.1. Storage and handling of hazardous materials will adhere to the DoD Component policies, including Joint Service Publication on Storage and Handling of Hazardous Materials. Defense Logistics Agency Instruction (DLAI) 4145.11, Army Technical Manual (TM) 38-410, Naval Supply Publication (NAVSUP PUB) 573, Air Force Joint Manual (AFJMAN) 23-209, and Marine Corps Order (MCO) 4450.12A (Storage and Handling of Hazardous Materials), provide additional guidance on the storage and handling of hazardous materials. The International Maritime Dangerous Goods (IMDG) Code and appropriate DoD and Component instructions provide requirements for international maritime transport of hazardous materials originating from DoD installations. International air shipments of hazardous materials originating from DoD installations are subject to International Civil Aviation Organization Technical Instructions or DoD Component guidance, including Air Force Interservice Manual 24-204(I), Army Technical Order (TO) 38-250, NAVSUP PUB 505, MCO P4030.19I, and DLAI 4145.3, DCMAD1, Ch3.4 (HM24), (Preparing Hazardous Materials for Military Air Shipments).

5.3.2. Hazardous material dispensing areas will be properly maintained. Drums/containers must not be leaking. Drip pans/absorbent materials will be placed under containers as necessary to collect drips or spills. Container contents will be clearly marked. Dispensing areas will be located away from catch basins and floor/storm drains.

5.3.3. Installations will ensure that for each hazardous material shipment:

5.3.3.1. The shipment is accompanied throughout by shipping papers that clearly describe the quantity and identity of the material and include an MSDS;

5.3.3.2. All drivers are trained on the hazardous material included in the shipment

including health risks of exposure and the physical hazards of the material, including potential for fire, explosion, and reactivity;

5.3.3.3. Drivers will be trained on spill control and emergency notification procedures;

5.3.3.4. For any hazardous material categorized on the basis of section AP1.1. of this Guide, the shipping papers and briefing for the driver include identification of the material in terms of the nine United Nations (UN) Hazard Classes;

5.3.3.5. The transport vehicles are subjected to a walk-around inspection by the driver before and after the hazardous material is loaded and may also be subjected to a request by the Competent Authority to conduct external and internal vehicle inspections (e.g. internal pressure levels)(Bahraini inspector requests shall be coordinated through the LEC); and

5.3.3.6. Packages are labeled in accordance with paragraph 5.3.7.

5.3.3.7. Transport shall be in accordance with paragraph 5.3.12.

5.3.3.8. Storage requirements shall be in accordance with paragraph 5.3.13.

5.3.4. Each installation will maintain a master listing of all storage locations for hazardous material as well as an inventory of all hazardous materials contained therein. (See paragraph 18.3.2.).

5.3.5. Each MSDS shall be in English or the predominant language in the work place, and shall contain at least the following information:

5.3.5.1. The identity used on the label.

5.3.5.1.1. If the hazardous chemical is a single substance, its chemical and common name.

5.3.5.1.2. If the hazardous chemical is a mixture that has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients that contribute to these known hazards, and the common name(s) of the mixture itself; or

5.3.5.1.3. If the hazardous chemical is a mixture that has not been tested as a whole:

5.3.5.1.3.1. The chemical and common name(s) of all ingredients that have been determined to be health hazards, and that comprise 1% or greater of the composition, except that chemicals identified as carcinogens shall be listed if the concentrations are 0.1% or greater;

5.3.5.1.3.2. The chemical and common name(s) of all ingredients that have been determined to be health hazards, and that comprise < 1% (0.1% for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations that would exceed an established Occupational Safety and Health Administration (OSHA)-permissible exposure limit, or could present a health hazard to employees; and

5.3.5.1.3.3. The chemical and common name(s) of all ingredients that have been determined to present a physical hazard when present in the mixture.

5.3.5.2. Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

5.3.5.3. The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity;

5.3.5.4. The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions that are generally recognized as being aggravated by exposure to the chemical;

5.3.5.5. The primary route(s) of entry (inhalation, skin absorption, ingestion, etc.);

5.3.5.6. The appropriate occupational exposure limit recommended by the chemical manufacturer, importer, or employer preparing the MSDS, where available;

5.3.5.7. Whether the hazardous chemical has been found to be a potential carcinogen;

5.3.5.8. Any generally applicable precautions for safe handling, storage, transportation, use, and disposal that are known to the chemical manufacturer, importer, or employer preparing the MSDS, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks;

5.3.5.9. Any generally applicable control measures that are known to the chemical manufacturer, importer, or employer preparing the MSDS, such as appropriate engineering controls, work practices, or personal protective equipment;

5.3.5.10. Emergency and first aid procedures;

5.3.5.11. The date of preparation of the MSDS or the last change to it; and

5.3.5.12. The name, address and telephone number of the chemical manufacturer, importer, employer, or other responsible party preparing or distributing the MSDS who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

5.3.6. Each work center will maintain a file of MSDSs for each hazardous material procured, stored, or used at the work center. MSDSs that are not contained in the HMIRS and those MSDSs prepared for locally purchased items should be incorporated into the HMIRS. A file of MSDS information not contained in the HMIRS should be maintained on site.

5.3.7. All hazardous materials on DoD installations will have Hazardous Chemical Warning Labels in accordance with DoD Instruction 6050.05, “DoD Hazard Communication (HAZCOM) Program” (or Bahraini equivalent) and have MSDS information either available or in the HMIRS

in accordance with DoD Instruction 6050.05, "DoD Hazard Communication (HAZCOM) Program" and other DoD Component instructions. These requirements apply throughout the life-cycle of these materials.

5.3.8. DoD installations will reduce the use of hazardous materials where practical through resource recovery, recycling, source reduction, acquisition, or other minimization strategies in accordance with Service guidance on improved hazardous material management processes and techniques.

5.3.9. All excess hazardous material will be processed through the Defense Logistics Agency (DLA) Disposition Services in accordance with the procedures in DoD 4160.21-M (Defense Materiel Disposition Manual). The DLA Disposition Services will only donate, transfer, or sell hazardous material to environmentally responsible parties. This paragraph is not intended to prohibit the transfer of usable hazardous material between DoD activities participating in a regional or local pharmacy or exchange program.

5.3.10. All personnel who use, handle, or store hazardous materials will be trained in accordance with DoD Instruction 6050.05, "DoD Hazard Communication (HAZCOM) Program" and other DoD Component instructions.

5.3.11. The installation must prevent the unauthorized entry of persons or livestock into the hazardous materials storage area.

5.3.12. Land carriers shall transport hazardous material in a safe manner.

5.3.12.1. Vehicles shall comply with the required speed limit and use the appropriate lanes identified for transport vehicles.

5.3.12.2. Vehicles shall be appropriately labelled on all sides of their outer surfaces indicating the level of danger of the contained substances. Labels shall be weather-resistant and painted in a reflecting color

5.3.12.3. Vehicles shall fix a yellow intermittent light on the driver cabin.

5.3.12.4. Installations transporting hazardous material shall consult the LEC to determine approval and licensing requirements for the transport method and drivers. Back up plans in case of accident or emergency are required for approval and licensing.

5.3.13. Installations shall comply with the following requirements for tanks/ containers used for storage of hazardous material:

5.3.13.1. Containers shall be made of a suitable material fit for the external environment (e.g. heat variation, vibration etc.) and the hazardous material.

5.3.13.2. Liquid hazardous material containers shall be coated on the inside to prevent corrosion or reaction.

5.3.13.3. Solid hazardous material containers shall not be made of cardboard but rather material strong enough to sustain transport conditions.

5.3.13.4. Containers shall be designed in accordance with international rules and regulations.

5.3.13.5. Contaners shall have an opening for inspection purposes.

5.3.13.6. Containers shall be equipped with an instrument to release pressure.

5.3.13.7. Filling activities shall comply with United Nations specifications.

5.3.13.8. Containers shall not be stacked up to a height beyond 3 meters (9.84 feet), unless stored on shelves.

5.3.14. Hazardous material storage areas shall be designed as follows:

5.3.14.1. Emergency exits shall be easily noticeable in case of darkness or thick smoke.

5.3.14.2. Suitable air filters/conditions in accordance to the stored substances shall be provided.

5.3.14.3. A smooth, non-slippery floor free of cracks shall be maintained.

5.3.14.4. Kitchen areas or changing facilities shall be situated no less than 10 meters (32.81 feet) from storage areas.

5.3.14.5. Grounding facilities for electrical circuits and appropriate protective gear in case of electrical sparks shall be provided inside storage units.

5.3.14.6. Battery charging and heating devices are prohibited from use inside storage areas.

5.3.14.7. Installations shall prepare a plan outlining the type of danger associated with each part of the storage area. The plan shall contain a list of places and amounts of the stored hazardous materials with the respective dangers, a list and the location of the emergency and fire resistant equipment, and the location of the emergency passages/exits. The plan must be regularly updated and kept in a place far away from the storage area.

5.3.15. Hazardous Material Approval. Installations may require approval for the handling of hazardous materials including their production, storage, transport, and use. Contact the LEC to determine approval requirements.

Table 5.1. Typical Hazardous Materials Characteristics

1. The item is a health or physical hazard. Health hazards include carcinogens, corrosive materials, irritants, sensitizers, toxic materials, and materials that damage the skin, eyes, or internal organs. Physical hazards include combustible liquids, compressed gases, explosives, flammable materials, organic peroxides, oxidizers, pyrophoric materials, unstable (reactive) materials and water-reactive materials.
2. The item and/or its disposal is regulated by the host nation because of its hazardous nature.
3. The item has a flashpoint below 93°C (200°F) closed cup, or is subject to spontaneous heating or is subject to polymerization with release of large amounts of energy when handled, stored, and shipped without adequate control.
4. The item is a flammable solid or is an oxidizer or is a strong oxidizing or reducing agent with a standard reduction potential of > 1.0 volt or < -1.0 volt.
5. In the course of normal operations, accidents, leaks, or spills, the item may produce dusts, gases, fumes, vapors, mists, or smokes with one or more of the above characteristics.
6. The item has special characteristics that, in the opinion of the manufacturer or the DoD Components, could cause harm to personnel if used or stored improperly.

CHAPTER 6

HAZARDOUS WASTE

6.1. SCOPE

This Chapter contains criteria for a comprehensive management program to ensure that hazardous waste is identified, stored, transported, treated, disposed and recycled in an environmentally sound manner.

6.2. DEFINITIONS

6.2.1. Acute Hazardous Waste. Those wastes listed in Table AP1.T4., "List of Hazardous Waste/Substances/Material." with a U.S. Environmental Protection Agency (USEPA) waste number with the "P" designator, or those hazardous wastes in Table AP1.T4. with Hazard Code "H".

6.2.2. Disposal. The discharge, deposit, injection, dumping, spilling, leaking, or placing of any hazardous waste into or on any land or water that would allow the waste or constituent to enter the environment. Proper disposal effectively mitigates hazards to human health and the environment.

6.2.3. DoD Hazardous Waste Generator. The Department of Defense considers a generator to be the installation, or activity on an installation, that produces a hazardous waste.

6.2.4. Hazardous Constituent. A chemical compound listed by name in Table AP1.T4., "List of Hazardous Waste/Substances/Material," or that possesses the characteristics described in section AP1.1.

6.2.5. Hazardous Waste. A discarded material that may be solid, semi-solid, liquid, or contained gas, and either exhibit a characteristic of a hazardous waste as defined in section AP1.1. or is listed as a hazardous waste in Tables AP1.T1. through AP1.T4. Excluded from this definition are domestic sewage sludge, and household and medical wastes not possessing the properties in Table 6.1.

6.2.5.1. It includes the following:

6.2.5.1.1. Discarded materials that contain one or more of the characteristics or properties described in 6.1 or 6.2.

6.2.5.1.2. All hazardous waste described in Tables 6.3 through 6.8.

6.2.5.1.3. Any other form of waste defined as hazardous by the Competent Authority

6.2.6. Hazardous Waste Accumulation Point (HWAP). A shop, site, or other work center where hazardous wastes are accumulated until removed to a Hazardous Waste Storage Area

(HWSA) or shipped for treatment or disposal. An HWAP may be used to accumulate no more than 208 liters (55 gallons) of hazardous waste, or 1 liter (1 quart) of acute hazardous waste, from each waste stream. The HWAP must be at or near the point of generation and under the control of the operator.

6.2.7. Hazardous Waste Fuel. Hazardous wastes burned for energy recovery. Fuel produced from hazardous waste by processing, blending, or other treatment is also hazardous waste fuel.

6.2.8. Hazardous Waste Generation. Any act or process that produces hazardous waste (HW) as defined in this Guide.

6.2.9. Hazardous Waste Profile Sheet (HWPS). A document that identifies and characterizes the waste by providing user's knowledge of the waste, and/or lab analysis, and details the physical, chemical, and other descriptive properties or processes that created the hazardous waste.

6.2.10. Hazardous Waste Storage Area (HWSA). One or more locations on a DoD installation where HW is collected prior to shipment for treatment or disposal. An HWSA may store more than ***208 liters*** (55 gallons) of a HW stream, and more than one quart of an acute HW stream.

6.2.11. Hazardous Waste Storage Area Manager. A person, or agency, on the installation assigned the operational responsibility for receiving, storing, inspecting, and general management of the installation's HWSA or HWSA program.

6.2.12. Land Disposal. Placement in or on the land, including, but not limited to, land treatment, facilities, surface impoundments, underground injection wells, salt dome formations, salt bed formations, underground mines or caves.

6.2.13. Treatment. Any method, technique, or process, excluding elementary neutralization, designed to change the physical, chemical, or biological characteristics or composition of any hazardous waste that would render such waste non-hazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.

6.2.14. Unique Identification Number. A number assigned to generators of hazardous waste to identify the generator and used to assist in tracking the waste from point of generation to ultimate disposal. The number could be the Unit Identification Code (UIC) or the DoD Activity Address Code (DoDAAC). The EEA should specify the method for determining the unique identification number in the FGS.

6.2.15. Used Oil Burned for Energy Recovery. Used oil that is burned for energy recovery is termed "used oil fuel." Used oil fuel includes any fuel produced from used oil by processing, blending, or other treatment. "Used oil," means any oil or other waste petroleum, oil, or lubricant (POL) product that has been refined from crude oil, or is synthetic oil, has been used and as a result of such use, is contaminated by physical or chemical impurities, or is off specification and cannot be used as intended. Although used oil may exhibit the characteristics of reactivity,

toxicity, ignitability, or corrosivity, it is still considered used oil, unless it has been mixed with hazardous waste. Used oil mixed with hazardous waste is a hazardous waste and will be managed as such.

6.2.16. Hazardous Waste Log. A listing of HW deposited and removed from an HWSA. Information such as the waste type, volume, location, and storage removal dates should be recorded.

6.2.17. Elementary Neutralization. A process of neutralizing a HW, that is hazardous only because of the corrosivity characteristic. It must be accomplished in a tank, transport vehicle, or container.

6.3. CRITERIA

6.3.1. DoD Hazardous Waste Generators

6.3.1.1. Hazardous Waste Determination and Characterization. Generators will identify and characterize the wastes generated at their site using their knowledge of the materials and processes that generated the waste or through laboratory analysis of the waste. Generators will identify inherent hazardous characteristics associated with a waste in terms of physical properties (e.g., solid, liquid, contained gases), chemical properties (e.g., chemical constituents, technical or chemical name), and/or other descriptive properties (e.g., ignitable, corrosive, reactive, toxic). The properties defining the characteristics should be measurable by standardized, and available testing protocols.

6.3.1.2**.** An HWPS will be used to identify each hazardous waste stream. Table 6.1 through Table 6.10 (appended to this FGS) shall also be utilized in the identification process. The HWPS must be updated by the generator, as necessary, to reflect any new waste streams, or process modifications that change the character of the hazardous waste being handled at the storage area.

6.3.1.3. Each generator will use a unique identification number for all recordkeeping, reports, and manifests for hazardous waste.

6.3.1.4. Pre-Transport Requirements.

6.3.1.4.1. Generators shall ensure that they comply with the following pre-transport requirements for hazardous waste:

6.3.1.4.1.1. Soundness of drums/containers

6.3.1.4.1.2. Labeling of drums and containers including generators name, quantity of HW and date of transportation

6.3.1.4.1.3. Waste transportation form accompanies the shipment

6.3.1.4.1.4. Waste carrier is approved by the Competent Authority

6.3.1.4.1.5. Waste is being delivered to a treatment unit or disposal site approved by the Competent Authority

6.3.1.4.2. Transportation

6.3.1.4.2.1. When transporting HW via commercial transportation on Bahrain public roads and highways, HW generators will prepare off-installation HW shipments in compliance with applicable Bahrain transportation regulations. Requirements may include placarding, marking, containerization and labeling. Hazardous waste designated for international transport will be prepared in accordance with applicable international regulations. In the absence of Bahrain regulations, international standards will be used.

6.3.1.4.2.2. When transporting HW via military vehicle on Bahrain public roads and highways, generators will ensure compliance with Service regulations for the transport of hazardous materials and, if required by applicable international agreement (Status of Forces Agreement (SOFA), basing, etc.), Bahrain transportation regulations such as those ensuring that:

6.3.1.4.2.2.1. Vehicle has a hazardous waste transport approval (Section 6.3.12).

6.3.1.4.2.2.2. Hazardous waste shipment is accompanied by a transportation form .

6.3.1.4.2.2.3. Hazardous chemical waste is accompanied by a MSDS and is compliant with chemical safety requirements of the Competent Authority.

6.3.1.4.2.2.4. Waste is transported to approved treatment units or disposal sites.

6.3.1.4.2.2.5. Vehicle placarding.

6.3.1.4.2.2.6. Over pack in the case of damage to drums or tanks.

6.3.1.4.2.2.7. Comply with spill response, disposal and area decontamination procedures during transport (see Chapter 16).

6.3.1.4.2.2.8. Transportation schedule or route is provided to the Competent Authority, if required.

6.3.1.4.3. Manifesting. All HW leaving the installation will be accompanied by a manifest to ensure a complete audit trail from point of origin to ultimate disposal. The manifest will include the information listed below. Bahrain waste transportation forms will be used when applicable, or the DD Form 1348-1A, “Issue Release/Receipt Document,” and DD Form 1348-2, “Issue Release/Receipt Document with Address Label,” may be used. This manifest should include:

6.3.1.4.3.1. Generator's name, address, and telephone number;

6.3.1.4.3.2. Generator's unique identification number;

6.3.1.4.3.3. Transporter's name, address, and telephone number;

6.3.1.4.3.4. Destination name, address, and telephone number;

6.3.1.4.3.5. Description of waste;

6.3.1.4.3.6. Total quantity of waste;

6.3.1.4.3.7. Date of shipment; and

6.3.1.4.3.8. Date of receipt.

6.3.1.4.4. Generators will maintain an audit trail of HW from the point of generation to disposal. Generators using DLA Disposition Services (DLA-DS) will obtain a signed copy of the manifest from the initial DLA Disposition Services recipient of the waste, at which time DLA-DS Services will assume responsibility. A generator, as provided in a host-tenant agreement, that uses the HW management and/or disposal program of a DoD Component that has a different unique identification number (see definition 6.2.14.) will obtain a signed copy of the manifest from the receiving component, at which time the receiving component will assume responsibility for subsequent storage, transfer, and disposal of the waste. Activities desiring to dispose of their HW outside DLA-DS system will develop their own manifest tracking system to provide an audit trail from point of generation to ultimate disposal.

6.3.2. Hazardous Waste Accumulation Point (HWAP)

6.3.2.1. An HWAP is defined in paragraph 6.2.6. Each HWAP must be designed and operated to provide appropriate segregation for different waste streams, including those that are chemically incompatible. Each HWAP will have warning signs (National Fire Protection Association or appropriate international sign) appropriate for the waste being accumulated at that site.

6.3.2.2. An HWAP will comply with the storage limits in paragraph 6.2.6. When these limits have been reached, the generator will make arrangements within five working days to move the HW to an HWSA or ship it off-site for treatment or disposal. Arrangements must include submission of all appropriate turn-in documents to initiate the removal (e.g., DD 1348-1A) to appropriate authorities responsible for removing the HW (e.g., DLA-DS). Wastes intended to be recycled or used for energy recovery (for example, used oil or antifreeze) are exempt from the 208-liter (55-gallons)/1-liter (1-quart) volume accumulation limits, but must be transported off-site to a final destination facility within one year.

6.3.2.3. All criteria of paragraph 6.3.4., “Use and Management of Containers,” apply to HWAPs with the exception of subparagraph 6.3.4.1.5., “Weekly Inspections.”

6.3.2.4. The following provisions of paragraph 6.3.5., "Recordkeeping Requirements," apply to HWAPs: 6.3.5.1. ("Turn-in Documents"), 6.3.5.5. ("Manifests"), and 6.3.5.6. ("Waste Analysis/Characterization Records").

6.3.2.5. Personnel Training. Personnel assigned HWAP duty must successfully complete appropriate HW training necessary to perform their assigned duties. At a minimum, this must include pertinent waste handling and emergency response procedures. Generic HW training requirements are described in paragraph 6.3.9.

6.3.3. Hazardous Waste Storage Area (HWSA)

6.3.3.1. Location Standards. To the maximum extent possible, all HWSAs will be located to minimize the risk of release due to seismic activity, floods, or other natural events. For facilities located where they may face such risks, the installation spill prevention and control plan must address the risk.

6.3.3.2. Design and Operation of HWSAs. HWSAs must be designed, constructed maintained, and operated to minimize the possibility of a fire, explosion, or any unplanned release of HW or HW constituents to air, soil, groundwater or surface water that could threaten human health or the environment. Hazardous waste should not be stored longer than one year in an HWSA.

6.3.3.3. Waste Analysis and Verification

6.3.3.3.1. Waste Analysis Plan. The HWSA manager, in conjunction with the installation(s) served will develop a plan to determine how and when wastes are to be analyzed. The waste analysis plan will include procedures for characterization (Section 6.3.1.1) and verification testing of both on-site and off-site hazardous waste. The plan should include: parameters for testing and rationale for choosing them, frequency of analysis, test methods, and sampling methods.

6.3.3.3.2. Maintenance of Waste Analysis File. The HWSA must have, and keep on file, an HWPS for each waste stream that is stored at each HWSA.

6.3.3.3.3. Waste Verification. Generating activities will provide identification of incoming waste on the HWPS to the HWSA manager. Prior to accepting the waste, the HWSA manager will:

6.3.3.3.3.1. Inspect the waste to ensure it matches the description provided.

6.3.3.3.3.2. Ensure that no waste is accepted for storage unless an HWPS is provided, or is available and properly referenced.

6.3.3.3.3.3. Request a new HWPS from the generator if there is reason to believe that the process generating the waste has changed;

6.3.3.3.4. Analyze waste shipments in accordance with the waste analysis plan to determine whether it matches the waste description on the accompanying manifest and documents; and

6.3.3.3.4.1. Reject shipments that do not match the accompanying waste descriptions unless the generator provides an accurate description.

6.3.3.4. Security

6.3.3.4.1. General. The installation must prevent the unknowing entry, and minimize the possibility for unauthorized entry, of persons or livestock onto the HWSA grounds.

6.3.3.4.2. Security System Design. An acceptable security system for a HWSA consists of either:

6.3.3.4.2.1. A 24-hour surveillance system (e.g., television monitoring or surveillance by guards or other designated personnel) that continuously monitors and controls entry into the HWSA; or

6.3.3.4.2.2. An artificial or natural barrier (e.g., a fence in good repair or a fence combined with a cliff) that completely surrounds the HWSA, combined with a means to control entrance at all times (e.g., an attendant, television monitors, locked gate, or controlled roadway access).

6.3.3.4.3. Required Signs. A sign with the legend "Danger Unauthorized Personnel Keep Out," must be posted at each entrance to the HWSA, and at other locations, in sufficient numbers to be seen from any approach to the HWSA. The legend must be written in English and in any other language predominant in the area surrounding the installation, and must be legible from a distance of at least 7.62 meters (25 feet). Existing signs with a legend other than "Danger Unauthorized Personnel Keep Out," may be used if the legend on the sign indicates that only authorized personnel are allowed to enter the HWSA, and that entry can be dangerous.

6.3.3.5. Required Aisle Space. Aisle space must allow for unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation during an emergency. Containers must not obstruct an exit.

6.3.3.6. Access to Communications or Alarm System

6.3.3.6.1. General. Whenever HW is being poured, mixed, or otherwise handled, all personnel involved in the operation must have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another person.

6.3.3.6.2. If there is only one person on duty at the HWSA premises, that person must have immediate access to a device, such as a telephone (immediately available at the scene of operation) or a hand-held two-way radio, capable of summoning external emergency assistance.

6.3.3.7. Required Equipment. All HWSAs must be equipped with the following:

6.3.3.7.1. An internal communications or alarm system capable of providing immediate emergency instruction (voice or signal) to HWSA personnel.

6.3.3.7.2. A device, such as an intrinsically safe telephone (immediately available at the scene of operations) or a hand-held two-way radio, capable of summoning emergency assistance from installation security, fire departments, or emergency response teams.

6.3.3.7.3. Portable fire extinguishers, fire control equipment appropriate to the material in storage (including special extinguishing equipment as needed, such as that using foam, inert gas, or dry chemicals), spill control equipment, and decontamination equipment.

6.3.3.7.4. Water at adequate volume and pressure to supply water hose streams, foam-producing equipment, automatic sprinklers, or water spray systems.

6.3.3.7.5. Readily available personal protective equipment appropriate to the materials stored, and eyewash and shower facilities.

6.3.3.7.6. Testing and Maintenance of Equipment. All HWSA communications alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be maintained to ensure its proper operation in time of emergency.

6.3.3.8. General Inspection Requirements

6.3.3.8.1. General. The installation must inspect the HWSA for malfunctions and deterioration, operator errors, and discharges that may be causing, or may lead to, a release of HW constituents to the environment or threat to human health. The inspections must be conducted often enough to identify problems in time to correct them before they harm human health or the environment.

6.3.3.8.2. Types of Equipment Covered. Inspections must include all equipment and areas involved in storage and handling of HW, including all containers and container storage areas, tank systems and associated piping, and all monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment (such as dikes and sump pumps) that are important to preventing, detecting, or responding to environmental or human health hazards.

6.3.3.8.3. Inspection Schedule. Inspections must be conducted according to a written schedule that is kept at the HWSA. The schedule must identify the types of problems (e.g., malfunctions or deterioration) that are to be looked for during the inspection (e.g., inoperative sump pump, leaking fitting, or eroding dike).

6.3.3.8.4. Frequency of Inspections. Minimum frequencies for inspecting containers and container storage areas are found in subparagraph 6.3.4.1.5. Minimum frequencies for inspecting tank systems are found in subparagraph 6.3.7.5.2. For equipment not covered by those paragraphs, inspection frequency should be based on the rate of possible deterioration of the

equipment and probability of an environmental or human health incident if the deterioration or malfunction or any operator error goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, must be inspected daily when in use.

6.3.3.8.5. Remedy of Problems Revealed by Inspection. The installation must remedy any deterioration or malfunction of equipment or structures that the inspection reveals on a schedule, which ensures that the problem does not lead to an environmental or human health hazard. Where a hazard is imminent or has already occurred, action must be taken immediately.

6.3.3.8.6. Maintenance of Inspection Records. The installation must record inspections in an inspection log or summary, and keep the records for at least three years from the date of inspection. At a minimum, these records must include the date and time of inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions.

6.3.3.9. Personnel Training. Personnel assigned HWSA duty must successfully complete an appropriate HW training program in accordance with the training requirements in paragraph 6.3.9.

6.3.3.10. Storage Practices

6.3.3.10.1. Compatible Storage. The storage of ignitable, reactive, or incompatible wastes must be handled so that it does not threaten human health or the environment. Incompatible hazardous waste types shall be kept in separate drums or containers and not mixed during waste transport. Dangers resulting from improper storage of incompatible wastes include generation of extreme heat, fire, explosion, and generation of toxic gases.

6.3.3.10.2. General requirements for ignitable, reactive, or incompatible wastes. The HWSA manager must take precautions to prevent accidental ignition or reaction of ignitable or reactive waste. This waste must be separated and protected from sources of ignition or reaction including but not limited to: open flames, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, or mechanical), spontaneous ignition (e.g., from heat producing chemical reactions), and radiant heat. While ignitable or reactive waste is being handled, the HWSA personnel must confine smoking and open flame to specially designated locations. "No Smoking" signs, or the appropriate icon, must be conspicuously placed wherever there is a hazard from ignitable or reactive waste. In areas where access by non-English speaking persons is expected, the "No Smoking" legend must be written in English and in any other language predominant in the area. Water reactive waste cannot be stored in the same area as flammable and combustible liquid.

6.3.3.11. Closure and Closure Plans

6.3.3.11.1. Closure. At closure of an HWSA, HW and HW waste residues must be removed from the containment system, including remaining containers, liners, and bases. Closure should be done in a manner which eliminates or minimizes the need for future maintenance or the potential for future releases of HW and according to the Closure Plan.

6.3.3.11.2. Closure Plan. Closure plans will be developed before a new HWSA is opened. Each existing HWSA will also develop a Closure Plan. The Closure Plan will be implemented concurrent with the decision to close the HWSA. The Closure Plan will include: estimates of the storage capacity of the HW, steps to be taken to remove or decontaminate all waste residues, and estimate of the expected date for closure.

6.3.4. Use and Management of Containers

6.3.4.1. Container Handling and Storage. To protect human health and the environment, the following guidelines will apply when handling and storing HW containers.

6.3.4.1.1. Containers holding HW will be in good condition, free from severe rusting, bulging, or structural defects.

6.3.4.1.2. Containers used to store HW, including overpack containers, must be compatible with the materials stored.

6.3.4.1.3. Management of Containers

6.3.4.1.3.1. A container holding HW must always be closed during storage, except when it is necessary to add or remove waste.

6.3.4.1.3.2. A container holding HW must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.

6.3.4.1.3.3. Containers of flammable liquids must be grounded when transferring flammable liquids from one container to the other.

6.3.4.1.4. Containers holding HW will be marked with a HW marking, and a label indicating the hazard class of the waste contained (flammable, corrosive, etc.).

6.3.4.1.5. Areas where containers are stored must be inspected weekly for leaking and deteriorating containers as well as deterioration of the containment system caused by corrosion or other factors. Secondary containment systems will be inspected for defects and emptied of accumulated releases or retained storm water.

6.3.4.2. Containment. Container storage areas must have a secondary containment system meeting the following:

6.3.4.2.1. Must be sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed.

6.3.4.2.2. The secondary containment system must have sufficient capacity to contain 10% of the volume of stored containers or the volume of the largest container, whichever is greater.

6.3.4.2.3. Storage areas that store containers holding only wastes that do not contain free liquids need not have a containment system as described in subparagraph 6.3.4.2.1., provided the storage area is sloped or is otherwise designed and operated to drain and remove liquid resulting from precipitation, or the containers are elevated or are otherwise protected from contact with accumulated liquid.

6.3.4.2.4. Rainwater captured in secondary containment areas should be inspected and/or tested prior to release. The inspection or testing must be reasonably capable of detecting contamination by the HW in the containers. Contaminated water shall be treated as HW until determined otherwise.

6.3.4.3. Special Requirements for Ignitable or Reactive Waste. Areas that store containers holding ignitable or reactive waste must be located at least 15 meters (50 feet) inside the installation's boundary.

6.3.4.4. Special Requirements for Incompatible Wastes

6.3.4.4.1. Incompatible wastes and materials must not be placed in the same container.

6.3.4.4.2. Hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material.

6.3.4.4.3. A storage container holding HW that is incompatible with any waste or other materials stored nearby in other containers, piles, open tanks, or surface impoundments, must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.

6.3.5. Recordkeeping Requirements

6.3.5.1. Turn-in Documents. Turn-in documents, e.g., DD 1348-1A, hazardous waste transportation forms or manifests, must be maintained for 3 years.

6.3.5.2. Hazardous Waste Log. A written HW log will be maintained at the HWSA to record all HW handled and should consist of the following:

6.3.5.2.1. Name/address of generator;

6.3.5.2.2. Description and hazard class of the hazardous waste;

6.3.5.2.3. Number and types of containers;

6.3.5.2.4. Quantity of hazardous waste;

6.3.5.2.5. Date stored;

6.3.5.2.6. Storage location; and

6.3.5.2.7. Disposition data, to include: dates received, sealed, and transported, and transporter used.

6.3.5.3. The HW log will be available to emergency personnel in the event of a fire or spill. Logs will be maintained until closure of the installation.

6.3.5.4. Inspection Logs. Records of inspections should be maintained for a period of 3 years.

6.3.5.5. Manifests. Manifests of incoming and outgoing hazardous wastes will be retained for a period of 3 years.

6.3.5.6. Waste Analysis/Characterization Records. These records will be retained until 3 years after closure of the HWSA.

6.3.5.7. The installation will maintain records, identified in subparagraphs 6.3.5.1., 6.3.5.5., and 6.3.5.6. for all HWAPs on the installation.

6.3.6. Contingency Plan

6.3.6.1. Each installation will have a contingency plan that describes actions to be taken to contain and clean up spills and releases of HW in accordance with the provisions of Chapter 18., "Spill Prevention and Response Planning."

6.3.6.2. A current copy of the installation contingency plan must be:

6.3.6.2.1. Maintained at each HWSA and HWAP, (HWAPs need maintain only portions of the contingency plan that are pertinent to their facilities and operation); and

6.3.6.2.2. Submitted to all police departments, fire departments, hospitals, and emergency response teams identified in the plan, and upon which the plan relies to provide emergency services. Contingency Plans should be available in both English and the language of the host nation.

6.3.7. Tank Systems. The following criteria apply to all storage tanks containing HW. See Chapter 19, "Underground Storage Tanks," for criteria dealing with underground storage tanks containing POLs and hazardous substances.

6.3.7.1. Application. The requirements of this subparagraph apply to HWSAs that use tank systems for storing or treating HW. Tank systems that are used to store or treat HW that contain no free liquids and are situated inside a building with an impermeable floor are exempted from the requirements in subparagraph 6.3.7.4., Containment and Detection of Releases. Tank systems, including sumps that serve as part of a secondary containment system to collect or contain releases of HW, are exempted from the requirements in subparagraph 6.3.7.4.

6.3.7.2. Assessment of the Integrity of an Existing Tank System. For each existing tank system that does not have secondary containment meeting the requirements of subparagraph 6.3.7.4., installations must determine annually whether the tank system is leaking or is fit for use. Installations must obtain, and keep on file at the HWSA, a written assessment of tank system integrity reviewed and certified by a competent authority.

6.3.7.3. Design and Installation of New Tank Systems or System Components. Managers of HWSAs installing new tank systems or system components must obtain a written assessment, reviewed and certified by a competent authority attesting that the tank system has sufficient structural integrity and is acceptable for storing and treating HW. The assessment must show that the foundation, structural support, seams, connections, and pressure controls (if applicable) are adequately designed and that the tank system has sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that it will not collapse, rupture, or fail.

6.3.7.4. Containment and Detection of Releases. To prevent the release of HW or hazardous constituents to the environment, secondary containment that meets the requirements of this subparagraph must be:

6.3.7.4.1. Provided for all new tank systems or components, prior to their being put into service;

6.3.7.4.2. Provided for those existing tank systems when the tank system annual leak test detects leakage;

6.3.7.4.3. Provided for tank systems that store or treat HW by 1 January 1999;

6.3.7.4.4. Designed, installed, and operated to prevent any migration of wastes or accumulated liquid out of the system to the soil, groundwater, or surface water at any time during the use of the tank system; and capable of detecting and collecting releases and accumulated liquid until the collected material is removed; and

6.3.7.4.5. Constructed to include one or more of the following: a liner external to the tank, a vault, or double-walled tank.

6.3.7.5. General Operating Requirements

6.3.7.5.1. Hazardous wastes or treatment reagents must not be placed in a tank system if they could cause the tank, its ancillary equipment, or the containment system to rupture, leak, corrode, or otherwise fail.

6.3.7.5.2. The installation must inspect and log at least once each operating day:

6.3.7.5.2.1. The above-ground portions of the tank system, if any, to detect corrosion or releases of waste;

6.3.7.5.2.2. Data gathered from monitoring and leak detection equipment (e.g., pressure or temperature gauges, monitoring wells) to ensure that the tank system is being operated according to its design; and

6.3.7.5.2.3. The construction materials and the area immediately surrounding the externally accessible portion of the tank system, including the secondary containment system (e.g., dikes) to detect erosion or signs of releases of HW (e.g., wet spots, dead vegetation).

6.3.7.5.3. The installation must inspect cathodic protection systems to ensure that they are functioning properly. The proper operation of the cathodic protection system must be confirmed within 6 months after initial installation and annually thereafter. All sources of impressed current must be inspected and/or tested, as appropriate, or at least every other month. The installation manager must document the inspections in the operating record of the HWSA.

6.3.7.5.4. During tank cleaning operations, HW or sludge generated must not be disposed of to soil, sewerage system, or the marine environment.

6.3.7.6. Response to Leaks or Spills and Disposition of Leaking or Unfit-For-Use Tank Systems. A tank system or secondary containment system from which there has been a leak or spill, or that is unfit for use, must be removed from service immediately and repaired or closed. Installations must satisfy the following requirements:

6.3.7.6.1. Cessation of use; prevention of flow or addition of wastes. The installation must immediately stop the flow of HW into the tank system or secondary containment system and inspect the system to determine the cause of the release.

6.3.7.6.2. Containment of visible releases to the environment. The installation must immediately conduct an inspection of the release and, based on that inspection:

6.3.7.6.2.1. Prevent further migration of the leak or spill to soil or surface water;

6.3.7.6.2.2. Remove and properly dispose of any contaminated soil or surface water;

6.3.7.6.2.3. Remove free product to the maximum extent possible; and

6.3.7.6.2.4. Continue monitoring and mitigating for any additional fire and safety hazards posed by vapors or free products in subsurface structures.

6.3.7.6.3. Make required notifications and reports.

6.3.7.6.4. Over pack HW drums damaged during transport.

6.3.7.7. Closure. At closure of a tank system, the installation must remove or decontaminate HW residues, contaminated containment system components (liners, etc.), contaminated soil to the extent practicable, and structures and equipment.

6.3.8. Standards for the Management of Used Oil and Lead-Acid Batteries

6.3.8.1. Used Oil Burned for Energy Recovery. Used oil fuel may be burned only in the following devices:

6.3.8.1.1. Industrial furnaces.

6.3.8.1.2. Boilers that are identified as follows:

6.3.8.1.2.1. Industrial boilers located on the site of a facility engaged in a manufacturing process where substances are transformed into new products, including the component parts of products, by mechanical or chemical processes;

6.3.8.1.2.2. Utility boilers used to produce electric power, steam, heated or cooled air, or other gases or fluids;

6.3.8.1.2.3. Used oil-fired space heaters provided that:

6.3.8.1.2.3.1. The heater burns only used oil that the installation generates;

6.3.8.1.2.3.2. The heater is designed to have a maximum capacity of not more than 0.15 MW (0.5 million BTU per hour); and

6.3.8.1.2.3.3. The combustion gases from the heater are properly vented to the ambient air.

.3.8.2. Prohibitions on Dust Suppression or Road Treatment. Used oil, HW, or used oil contaminated with any HW will not be used for dust suppression or road treatment.

6.3.8.3. Lead-acid batteries that are to be recycled will be managed as hazardous material. Lead-acid batteries that are not recycled will be managed as HW.

6.3.8.4. Additional Used Oil Criteria. Additional criteria for the management of used oil are included in Chapter 9, “POL”.

6.3.9. Hazardous Waste Training

6.3.9.1. Application. Personnel and their supervisors who are assigned duties involving actual or potential exposure to HW must successfully complete an appropriate training program prior to assuming those duties. Personnel assigned to such duty after the effective date of this Guide must work under direct supervision until they have completed appropriate training. Additional guidance is contained in DoDI 6050.05 (DoD Hazard Communication (HAZCOM) Program).

6.3.9.2. Refresher Training. All personnel performing HW duties must successfully complete annual refresher HW training.

6.3.9.3. Training Contents and Requirements. The training program must:

6.3.9.3.1. Include sufficient information to enable personnel to perform their assigned duties and fully comply with pertinent HW requirements.

6.3.9.3.2. Be conducted by qualified trainers who have completed an instructor training program in the subject, have comparable academic credentials, or experience.

6.3.9.3.3. Be designed to ensure that facility personnel are able to respond effectively to emergencies by familiarizing them with emergency procedures, emergency equipment, and emergency systems.

6.3.9.3.4. Address the following areas, in particular for personnel whose duties include HW handling and management:

6.3.9.3.4.1. Emergency procedures (response to fire/explosion/spills; use of communications/alarm systems; body and equipment clean up);

6.3.9.3.4.2. Drum/container handling/storage; safe use of HW equipment; proper sampling procedures;

6.3.9.3.4.3. Employee Protection, to include Personal Protective Equipment (PPE), safety and health hazards, hazard communication, worker exposure; and

6.3.9.3.4.4. Recordkeeping, security, inspections, contingency plans, storage requirements, and transportation requirements.

6.3.9.4. Documentation of Training. Installations must document all HW training for each individual assigned duties involving actual or potential exposure to HW. Updated training records on personnel assigned duties involving actual or potential exposure to HW must be kept by the HWSA manager or the responsible installation office and retained for at least three years after termination of duty of these personnel.

6.3.10. Hazardous Waste Disposal

6.3.10.1. All DoD HW should normally be disposed of through DLA Disposition Services. A decision not to use DLA-DS for HW disposal may be made in accordance with DoDD 4001.1 (Installation Management) to best accomplish the installation mission, but should be concurred with by the component chain of command to ensure that installation contracts and disposal criteria are at least as protective as criteria used by DLA-DS.

6.3.10.2. The DoD Components must ensure that wastes generated by DoD operations and considered hazardous under either U.S. law or Bahrain law are not disposed of in the host nation unless the disposal is conducted in accordance with FGS and the following:

6.3.10.2.1. When HW cannot be disposed of in accordance with FGS within the host nation, it will either be retrograded to the United States or, if permissible under international

agreements, transferred to another country outside the United States where it can be disposed of in an environmentally sound manner and in compliance with FGS applicable to the country of disposal, if any exist. Transshipment of HW to a country other than the United States for disposal must be approved by, at a minimum, the DUSD(I&E). The following record-keeping requirements apply for HW disposed outside Bahrain:

6.3.10.2.1.1. Generators may be required to provide a notification containing the information in Table 6.12. Installations shall contact the LEC to determine Competent Authority notification requirements. When required, a general notification shall be used for regular shipments of hazardous wastes with the same physical and chemical characteristics.

6.3.10.2.1.2. Waste shipments outside of Bahrain shall be accompanied by the waste transportation form and additional required information included in Table 6.13.

6.3.10.2.2. The determination of whether particular DoD-generated HW may be disposed of in a host nation will be made by the EEA, in coordination with the unified combatant commander, the Director of Defense Logistics Agency, other relevant DoD Components, and the Chief of the U.S. Diplomatic Mission.

6.3.10.2.3. Generators shall notify the Competent Authority via the LEC in writing in the event of rejection of hazardous waste shipments by the treatment unit or disposal site and comply with its procedures for disposal. The following requirements shall be met when sending HW for treatment/disposal:

6.3.10.2.3.1. Installations shall use approved carriers

6.3.10.2.3.2. HW shall be accompanied with the completed waste transportation form

6.3.10.2.3.3. HW shall conform with the description on the completed waste transportation form

6.3.10.2.3.4. Chemical or biological waste shall be accompanied by its MSDS

6.3.10.3. Disposal Procedures

6.3.10.3.1. The determination of whether HW may be disposed of in a host nation must include consideration of whether the means of treatment and/or containment technologies employed in the Bahrain program, as enacted and enforced, effectively mitigate the hazards of such waste to human health and the environment, and must consider whether the Bahrain program includes:

6.3.10.3.1.1. An effective system for tracking the movement of HW to its ultimate destination.

6.3.10.3.1.2. An effective system for granting authorization or permission to those engaged in the collection, transportation, storage, treatment, and disposal of HW.

6.3.10.3.1.3. Appropriate standards and limitations on the approved methods that may be used to treat and dispose of HW.

6.3.10.3.1.4. Standards designed to minimize the possibility of fire, explosion, or any unplanned release or migration of HW or its constituents to air, soil, surface, or groundwater.

6.3.10.3.2. The EEA must also be satisfied, either through reliance on the HN regulatory system and/or provisions in the disposal contracts, that:

6.3.10.3.2.1. Persons and facilities in the waste management process have demonstrated the appropriate level of training and reliability; and

6.3.10.3.2.2. Effective inspections, monitoring, and recordkeeping will take place.

6.3.10.3.2.2.1. A monitoring program for the treatment unit and all its facilities and equipment including storage areas, emergency equipment, and safety program shall be developed.

6.3.10.3.2.2.2. See Section 6.3.5. for record-keeping requirements (e.g. waste transportation forms, Operation Register, etc.)

6.3.10.4. Bahrain facilities that either store, treat, or dispose of DoD-generated waste must be evaluated and approved by the host nation as being in compliance with their regulatory requirements. This evaluation and approval may-consist of having a valid permit or HN equivalent for the HW that will be handled.

6.3.10.5. Hazardous waste will be recycled or reused to the maximum extent practical. Generators shall work toward preventing or reducing waste generation by upgrading equipment, adopting safe and environmentally acceptable methods to identify, store, prevent leakage, and dispose of HW, to minimize risks to health and the environment. They shall also take into account social, technological and economic aspects of the appropriate measures to ensure that the generation of hazardous wastes and other wastes is reduced to a minimum.

6.3.10.6. Land Disposal Requirements. Hazardous wastes will only be land-disposed when there is a reasonable degree of certainty that there will be no migration of hazardous constituents from the disposal site for as long as the wastes remain hazardous. Hazardous waste may be land-disposed only in facilities meeting the following criteria:

6.3.10.6.1. The land disposal facility has a liner and a leachate collection system. The liner will be of natural or man-made materials and restrict the downward or lateral escape of HW, hazardous constituents, or leachate. The permeability of such liners will be no greater than 10^{-7} cm/sec;

6.3.10.6.2. The land disposal facility has a groundwater monitoring program capable of determining the facility's impact on the quality of water in the aquifers underlying the facility

as well as monitoring programs for soil, air emissions, industrial drainage water, and hazardous waste treatment products; and

6.3.10.6.3. The requirements of subparagraphs 6.3.10.6.1. or 6.3.10.6.2., above, may be waived for a particular land disposal facility by the LEC if a written determination is made by a qualified geologist or geotechnical engineer that there is a low potential for migration of HW, hazardous constituents, or leachate from the facility to water supply wells, irrigation wells, or surface water. This determination will be based on an analysis of local precipitation, geologic conditions, physical properties, depth to groundwater, and proximity of water supply wells or surface water, as well as use of alternative design and operating practices. Methods for preventing migration will be at least as effective as liners and leachate collection systems required in subparagraph 6.3.10.6.1.

6.3.10.7. Incinerator Standards. This subparagraph applies to incinerators that incinerate HW as well as boilers and industrial furnaces that burn HW for any recycling purposes.

6.3.10.7.1. Incinerators used to dispose of HW must be licensed or permitted by a component HN authority or approved by the EEA. This license, permit, or approval must comply with the criteria listed in subparagraph 6.3.10.7.2.

6.3.10.7.2. A license, permit, or EEA approval for incineration of HW must require the incinerator to be designed to include appropriate equipment as well as to be operated according to management practices (including proper combustion temperature, waste feed rate, combustion gas velocity, and other relevant criteria) to effectively destroy hazardous constituents and control harmful emissions. A permitting, licensing, or approval scheme that would require an incinerator to achieve the standards set forth in either subparagraphs 6.3.10.7.2.1. or 6.3.10.7.2.2. is acceptable.

6.3.10.7.2.1. The incinerator achieves a destruction and removal efficiency of 99.99% for the organic hazardous constituents that represent the greatest degree of difficulty of incineration in each waste or mixture of waste. The incinerator must minimize carbon monoxide in stack exhaust gas, minimize emission of particulate matter, and emit no more than 1.8 Kg (4 pounds) of hydrogen chloride per hour.

6.3.10.7.2.2. The incinerator has demonstrated, as a condition for obtaining a license, permit, or EEA approval, the ability to effectively destroy the organic hazardous constituents that represent the greatest degree of difficulty of incineration in each waste or mixture of waste to be burned. For example, this standard may be met by requiring the incinerator to conduct a trial burn, submit a waste feed analysis and detailed engineering description of the facility, and provide any other information that may be required to enable the competent HN authority or the EEA to conclude that the incinerator will effectively destroy the principal organic hazardous constituents of each waste to be burned.

6.3.10.8. Treatment Technologies. The following treatment technologies may be used to reduce the volume or hazardous characteristics of wastes. Wastes categorized as hazardous on the basis of section AP1.1. and which, after treatment as described herein, no longer exhibit any hazardous characteristic, may be disposed of as solid waste. Treatment residues of wastes

categorized as hazardous under any other section of Appendix 1 will continue to be managed as HW under the criteria of this Guide, including those for disposal. The treatment technologies listed below are provided as baseline treatment/disposal technologies for use in determining suitability of HN disposal alternatives. These technologies should not be implemented without consultation with the EEA, or the Combatant Commander, if there is no EEA.

6.3.10.8.1. Organics

6.3.10.8.1.1. Incineration in accordance with the requirements of subparagraph 6.3.10.7.1.

6.3.10.8.1.2. Fuel substitution where the units are operated such that destruction of hazardous constituents are at least as efficient, and hazardous emissions are no greater than those produced by incineration.

6.3.10.8.1.3. Biodegradation. Wastes are degraded by microbial action. Such units will be operated under aerobic or anaerobic conditions so that the concentrations of a representative compound or indicator parameter (e.g., total organic carbon) has been substantially reduced in concentration. The level to which biodegradation must occur and the process time vary depending on the HW being biodegraded.

6.3.10.8.1.4. Recovery. Wastes are treated to recover organic compounds. This will be done using, but not limited to, one or more of the following technologies: distillation; thin film evaporation; steam stripping; carbon adsorption; critical fluid extraction; liquid extraction; precipitation/crystallization, or phase separation techniques, such as decantation, filtration, and centrifugation when used in conjunction with one of the above techniques.

6.3.10.8.1.5. Chemical Degradation. The wastes are chemically degraded in such a manner to destroy hazardous constituents and control harmful emissions.

6.3.10.8.2. Heavy Metals

6.3.10.8.2.1. Stabilization or Fixation. Wastes are treated in such a way that soluble heavy metals are fixed by oxidation/reduction, or by some other means that renders the metals immobile in a landfill environment.

6.3.10.8.2.2. Recovery. Wastes are treated to recover the metal fraction by thermal processing, precipitation, exchange, carbon absorption, or other techniques that yield non-hazardous levels of heavy metals in the residuals.

6.3.10.8.3. Reactives. Any treatment that changes the chemical or physical composition of a material so it no longer exhibits the characteristic for reactivity defined in Appendix 1.

6.3.10.8.4. Corrosives. Corrosive wastes as defined in paragraph AP1.1.3., will be neutralized to a pH value between 6.0 and 9.0. Other acceptable treatments include recovery, incineration, chemical or electrolytic oxidation, chemical reduction, or stabilization.

6.3.10.8.5. Batteries. Mercury, nickel-cadmium, lithium, and lead-acid batteries will be processed in accordance with subparagraphs 6.3.10.8.2.1. or 6.3.10.8.2.2. to stabilize, fix or recover heavy metals, as appropriate, and in accordance with subparagraph 6.3.10.8.4. to neutralize any corrosives before disposal.

6.3.10.9. DoD generators of HW shall not treat HW at the point of generation except for elementary neutralization. This shall not preclude installations from treating HW in accord with subparagraphs 6.3.10.7. and 6.3.10.8. On-site treatment units shall be approved via the LEC by the Competent Authority (see Section 6.3.12); alternatively, HW may be sent to an off-site treatment unit or disposal site.

6.3.11. Record-Keeping Requirements for Treatment Units. The following records shall be maintained by treatment units:

6.3.11.1. Operations Register for no less than three years which includes the following information:

6.3.11.1.1. Quantity and quality of waste shipments including both name of generator, carrier, date of receipt and treatment or disposal

6.3.11.1.2. Description of waste/secondary remains post-treatment including quantity, method and site of disposal

6.3.11.1.3. Analysis results (emissions to air, pollutants in soil/ groundwater and pollutant concentrations in sludge, industrial drainage waste or secondary waste from the treatment process) and describing the quantity, method and site of disposal for waste remaining from the treatment process

6.3.11.2. Periodic report regarding treatment unit/ disposal site activities submitted to the Competent Authority via the LEC every 6 months from the date of operation and whenever requested by the Competent Authority. It shall contain details and measures as per the criteria in Section 6.3.11.1

6.3.12. Hazardous Waste Approval. Installations may require approval for the transport off installation and treatment or disposal of hazardous wastes. Contact the LEC to determine approval requirements.

Table 6.1. List of hazardous characteristics

UN Class[1]	Code	Characteristics
1	H1	Explosive: An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.
3	H3	Flammable liquids: The word "flammable" has the same meaning as "inflammable". Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapor at temperatures of not more than 60.5ºC, closed-cup test, or not more than 65.6ºC, open-cup test. (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition.)
4.1	H4.1	Flammable solids: Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.
4.2	H4.2	Substances or wastes liable to spontaneous combustion: Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.
4.3	H4.3	Substances or wastes which, in contact with water emit flammable gases: Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.
5.1	H5.1	Oxidizing: Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or contribute to, the combustion of other materials.
5.2	H5.2	Organic Peroxides: Organic substances or wastes which contain the bivalent-o-o-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.
6.1	H6.1	Poisonous (Acute): Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.
6.2	H6.2	Infectious substances: Substances or wastes containing viable microorganisms or their toxins which are known or suspected to cause disease in animals or humans.
8	H8	Corrosives: Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.
9	H10	Liberation of toxic gases in contact with air or water: Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.
9	H11	Toxic (Delayed or chronic): Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.
9	H12	Ecotoxic: Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
9	H13	Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.

Table 6.2. Controlled Waste Categories

Code	A – Wastes Streams
Y1	Clinical wastes from medical care in hospitals, medical centers and clinics
Y2	Wastes from the production and preparation of pharmaceutical products
Y3	Waste pharmaceuticals, drugs and medicines
Y4	Wastes from the production, formulation and use of biocides and phytopharmaceuticals
Y5	Wastes from the manufacture, formulation and use of wood preserving chemicals
Y6	Wastes from the production, formulation and use of organic solvents
Y7	Wastes from heat treatment and tempering operations containing cyanides
Y8	Waste mineral oils unfit for their originally intended use
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsions
Y10	Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Y11	Waste tarry residues arising from refining, distillation and any pyrolytic treatment
Y12	Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish
Y13	Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives
Y14	Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known
Y15	Wastes of an explosive nature not subject to other legislation
Y16	Wastes from production, formulation and use of photographic chemicals and processing materials
Y17	Wastes resulting from surface treatment of metals and plastics
Y18	Residues arising from industrial waste disposal operations
	B – Waste Having The Following As Constituents
Y19	Metal carbonyls
Y20	Beryllium; beryllium compounds
Y21	Hexavalent chromium compounds
Y22	Copper compounds
Y23	Zinc compounds
Y24	Arsenic; arsenic compounds
Y25	Selenium; selenium compounds
Y26	Cadmium; cadmium compounds
Y27	Antimony; antimony compounds
Y28	Tellurium; tellurium compounds
Y29	Mercury; mercury compounds
Y30	Thallium; thallium compounds
Y31	Lead; lead compounds
Y32	Inorganic fluorine compounds excluding calcium fluoride
	B – Waste Having The Following As Constituents
Y33	Inorganic cyanides
Y34	Acidic solutions or acids in solid form
Y35	Basic solutions or bases in solid form
Y36	Asbestos (dust and fibers)
Y37	Organic phosphorus compounds
Y38	Organic cyanides
Y39	Phenols; phenol compounds including chlorophenols
Y40	Ethers
Y41	Halogenated organic solvents
Y42	Organic solvents excluding halogenated solvents
Y43	Any congenor of polychlorinated dibenzo-furan
Y44	Any congenor of polychlorinated dibenzo-p-dioxin
Y45	Organohalogen compounds other than substances referred to in this Table (e.g. Y39, Y41, Y42, Y43, Y44)
	C – Categories of Waste Requiring Special Consideration
Y46	Wastes collected from households

Y47	Residues arising from the incineration of household wastes

Table 6.3. Wastes Characterized as Hazardous Metal and Metal-Bearing

A1010	Metal wastes and waste consisting of alloys of any of the following: • Antimony • Arsenic • Beryllium • Cadmium • Lead • Mercury • Selenium • Tellurium • Thallium but excluding such wastes specifically listed on list B.
A1020	Waste having as constituents or contaminants, excluding metal waste in massive form, any of the following: • Antimony; antimony compounds • Beryllium; beryllium compounds • Cadmium; cadmium compounds • Lead; lead compounds • Selenium; selenium compounds • Tellurium; tellurium compounds
A1030	Wastes having as constituents or contaminants any of the following: • Arsenic; arsenic compounds • Mercury; mercury compounds • Thallium; thallium compounds
A1040	Wastes having as constituents any of the following: • Metal carbonyls • Hexavalent chromium compounds
A1050	Galvanic sludges
A1060	Waste liquors from the pickling of metals
A1070	Leaching residues from zinc processing, dust and sludges such as jarosite, hematite, etc.
A1080	Waste zinc residues not included on list B, containing lead and cadmium in concentrations sufficient to exhibit Table 6.1 characteristics
A1090	Ashes from the incineration of insulated copper wire
A1100	Dusts and residues from gas cleaning systems of copper smelters
A1110	Spent electrolytic solutions from copper electrorefining and electrowinning operations
A1120	Waste sludges, excluding anode slimes, from electrolyte purification systems in copper electrorefining and electrowinning operations
A1130	Spent etching solutions containing dissolved copper
A1140	Waste cupric chloride and copper cyanide catalysts
A1150	Precious metal ash from incineration of printed circuit boards not included on list B[1]
A1160	Waste lead-acid batteries, whole or crushed
A1170	Unsorted waste batteries excluding mixtures of only list B batteries. Waste batteries not specified on list B containing Table 6.2 A, B and C constituents to an extent to render them hazardous
A1180	Waste electrical and electronic assemblies or scrap[2] containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or contaminated with Table 6.2 constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) to an extent that

[1] Note that mirror entry on list B (B1160) does not specify exceptions.

[2] This entry does not include scrap assemblies from electric power generation.

Table 6.3. Wastes Characterized as Hazardous Metal and Metal-Bearing

	they possess any of the characteristics contained in Table 6. 1 (note the related entry on list B B1110)[3]

[3] PCBs are at a concentration level of 50 mg/kg or more.

Table 6.4. Wastes Containing Principally Inorganic Constituents, which may Contain Metals and Organic Materials

A2010	Glass waste from cathode-ray tubes and other activated glasses
A2020	Waste inorganic fluorine compounds in the form of liquids or sludges but excluding such wastes specified on list B
A2030	Waste catalysts but excluding such wastes specified on list B
A2040	Waste gypsum arising from chemical industry processes, when containing Table 6.22 constituents to the extent that it exhibits an Table 6.1 hazardous characteristic (note the related entry on list B B2080)
A2050	Waste asbestos (dusts and fibers)
A2060	Coal-fired power plant fly-ash containing Table 6.2 substances in concentrations sufficient to exhibit Table 6.1 characteristics (note the related entry on list B B2050)

Table 6.5. Wastes Containing Principally Organic Constituents, which may Contain Metals and Inorganic Materials

A3010	Waste from the production or processing of petroleum coke and bitumen
A3020	Waste mineral oils unfit for their originally intended use
A3030	Wastes that contain, consist of or are contaminated with leaded anti-knock compound sludges
A3040	Waste thermal (heat transfer) fluids
A3050	Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives excluding such wastes specified on list B (note the related entry on list B B4020)
A3060	Waste nitrocellulose
A3070	Waste phenols, phenol compounds including chlorophenol in the form of liquids or sludges
A3080	Waste ethers not including those specified on list B
A3090	Waste leather dust, ash, sludges and flours when containing hexavalent chromium compounds or biocides (note the related entry on list B B3100)
A3100	Waste paring and other waste of leather or of composition leather not suitable for the manufacture of leather articles containing hexavalent chromium compounds or biocides (note the related entry on list B B3090)
A3110	Fellmongery wastes containing hexavalent chromium compounds or biocides or infectious substances (note the related entry on list B B3110)
A3120	Fluff - light fraction from shredding
A3130	Waste organic phosphorous compounds
A3140	Waste non-halogenated organic solvents but excluding such wastes specified on list B
A3150	Waste halogenated organic solvents
A3160	Waste halogenated or unhalogenated non-aqueous distillation residues arising from organic solvent recovery operations
A3170	Wastes arising from the production of aliphatic halogenated hydrocarbons (such as chloromethane, dichloro-ethane, vinyl chloride, vinylidene chloride, allyl chloride and epichlorhydrin)
A3180	Wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyl (PCB), polychlorinated terphenyl (PCT), polychlorinated naphthalene (PCN) or polybrominated biphenyl (PBB), or any other polybrominated analogues of these compounds, at a concentration level of 50 mg/kg or more[4]

[4] The 50 mg/kg level is considered to be an internationally practical level for all wastes. However, many individual

A3190	Waste tarry residues (excluding asphalt cements) arising from refining, distillation and any pyrolitic treatment of organic materials

countries have established lower regulatory levels (e.g., 20 mg/kg) for specific wastes.

Table 6.6. Wastes which may Contain Either Inorganic or Organic Constituents

A4010	Wastes from the production, preparation and use of pharmaceutical products but excluding such wastes specified on list B
A4020	Clinical and related wastes; that is wastes arising from medical, nursing, dental, veterinary, or similar practices, and wastes generated in hospitals or other facilities during the investigation or treatment of patients, or research projects
A4030	Wastes from the production, formulation and use of biocides and phytopharmaceuticals, including waste pesticides and herbicides which are off-specification, outdated,[5] or unfit for their originally intended use
A4040	Wastes from the manufacture, formulation and use of wood-preserving chemicals[6]
A4050	Wastes that contain, consist of or are contaminated with any of the following: • Inorganic cyanides, excepting precious-metal-bearing residues in solid form containing traces of inorganic cyanides • Organic cyanides
A4060	Waste oils/water, hydrocarbons/water mixtures, emulsions
A4070	Wastes from the production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish excluding any such waste specified on list B (note the related entry on list B B4010)
A4080	Wastes of an explosive nature (but excluding such wastes specified on list B)
A4090	Waste acidic or basic solutions, other than those specified in the corresponding entry on list B (note the related entry on list B B2120)
A4100	Wastes from industrial pollution control devices for cleaning of industrial off-gases but excluding such wastes specified on list B
A4110	Wastes that contain, consist of or are contaminated with any of the following: • Any congenor of polychlorinated dibenzo-furan • Any congenor of polychlorinated dibenzo-dioxin
A4120	Wastes that contain, consist of or are contaminated with peroxides
A4130	Waste packages and containers containing Table 6.2 substances in concentrations sufficient to exhibit Table 6.1 hazard characteristics
A4140	Waste consisting of or containing off specification or outdated[7] chemicals corresponding to Table 6.2 A, B and C categories and exhibiting Table 6.1 hazard characteristics
A4150	Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on human health and/or the environment are not known
A4160	Spent activated carbon not included on list B (note the related entry on list B B2060)

[5] "Outdated" means unused within the period recommended by the manufacturer.
[6] This entry does not include wood treated with wood preserving chemicals.
[7] "Outdated" means unused within the period recommended by the manufacturer.

Table 6.7. B1 Metal and Metal-Bearing Wastes

B1010	Metal and metal-alloy wastes in metallic, non-dispersible form: • Precious metals (gold, silver, the platinum group, but not mercury) • Iron and steel scrap • Copper scrap • Nickel scrap • Aluminum scrap • Zinc scrap • Tin scrap • Tungsten scrap • Molybdenum scrap • Tantalum scrap • Magnesium scrap • Cobalt scrap • Bismuth scrap • Titanium scrap • Zirconium scrap • Manganese scrap • Germanium scrap • Vanadium scrap • Scrap of hafnium, indium, niobium, rhenium and gallium • Thorium scrap • Rare earths scrap • Chromium scrap
B1020	Clean, uncontaminated metal scrap, including alloys, in bulk finished form (sheet, plate, beams, rods, etc), of: • Antimony scrap • Beryllium scrap • Cadmium scrap • Lead scrap (but excluding lead-acid batteries) • Selenium scrap • Tellurium scrap
B1030	Refractory metals containing residues
B1040	Scrap assemblies from electrical power generation not contaminated with lubricating oil, PCB or PCT to an extent to render them hazardous
B1050	Mixed non-ferrous metal, heavy fraction scrap, not containing Table 6.2 A, B and C type materials in concentrations sufficient to exhibit Table 6.1 characteristics[8]
B1060	Waste selenium and tellurium in metallic elemental form including powder
B1070	Waste of copper and copper alloys in dispersible form, unless they contain Table 6.2 constituents to an extent that they exhibit Table 6.1 characteristics
B1080	Zinc ash and residues including zinc alloys residues in dispersible form unless containing Table 6.2 A, B and C type constituents in concentration such as to exhibit Table 6.1 characteristics or exhibiting hazard characteristic H4.3 (Table 6.1)[9]
B1090	Waste batteries conforming to a specification, excluding those made with lead, cadmium or mercury

[8] Note that even where low level contamination with these materials initially exists, subsequent processes, including recycling processes, may result in separated fractions containing significantly enhanced concentrations of these materials.

[9] The status of zinc ash is currently under review.

Table 6.7. B1 Metal and Metal-Bearing Wastes

<table>
<tr><td>B1100</td><td>Metal-bearing wastes arising from melting, smelting and refining of metals:
• Hard zinc scrap
• Zinc-containing drosses:
- Galvanizing slab zinc top dross (>90% Zn)
- Galvanizing slab zinc bottom dross (>92% Zn)
- Zinc die casting dross (>85% Zn)
- Hot dip galvanizers slab zinc dross (batch)(>92% Zn)
- Zinc skimmings
• Aluminum skimmings (or skims) excluding salt slag
• Slags from copper processing for further processing or refining not containing arsenic, lead or cadmium to an extent that they exhibit Table 6.1 hazard characteristics
• Wastes of refractory linings, including crucibles, originating from copper smelting
• Slags from precious metals processing for further refining
• Tantalum-bearing tin slags with less than 0.5% tin</td></tr>
<tr><td>B1110</td><td>Electrical and electronic assemblies:
• Electronic assemblies consisting only of metals or alloys
• Waste electrical and electronic assemblies or scrap[10] (including printed circuit boards) not containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or not contaminated with Table 6.2 constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) or from which these have been removed, to an extent that they do not possess any of the characteristics contained in Table 6.1 (note the related entry on list A A1180)
• Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse,[11] and not for recycling or final disposal[12]</td></tr>
<tr><td>B1120</td><td>Spent catalysts excluding liquids used as catalysts, containing any of:
<table>
<tr><td>Transition metals, excluding waste catalysts (spent catalysts, liquid used catalysts or other catalysts) on list A:</td><td>Scandium
Vanadium
Manganese
Cobalt
Copper
Yttrium
Niobium
Hafnium
Tungsten</td><td>Titanium
Chromium
Iron
Nickel
Zinc
Zirconium
Molybdenum
Tantalum
Rhenium</td></tr>
<tr><td>Lanthanides (rare earth metals):</td><td>Lanthanum
Praseodymium
Samarium
Gadolinium
Dysprosium
Erbium
Ytterbium</td><td>Cerium
Neody
Europium
Terbium
Holmium
Thulium
Lutetium</td></tr>
</table></td></tr>
</table>

[10] This entry does not include scrap from electrical power generation.
[11] Reuse can include repair, refurbishment or upgrading, but not major reassembly
[12] In some countries these materials destined for direct re-use are not considered wastes.

Table 6.7. B1 Metal and Metal-Bearing Wastes

B1130	Cleaned spent precious-metal-bearing catalysts
B1140	Precious-metal-bearing residues in solid form which contain traces of inorganic cyanides
B1150	Precious metals and alloy wastes (gold, silver, the platinum group, but not mercury) in a dispersible, non-liquid form with appropriate packaging and labeling
B1160	Precious-metal ash from the incineration of printed circuit boards (note the related entry on list A, A1150)
B1170	Precious-metal ash from the incineration of photographic film
B1180	Waste photographic film containing silver halides and metallic silver
B1190	Waste photographic paper containing silver halides and metallic silver
B1200	Granulated slag arising from the manufacture of iron and steel
B1210	Slag arising from the manufacture of iron and steel including slags as a source of TiO_2 and vanadium
B1220	Slag from zinc production, chemically stabilized, having a high iron content (above 20%) and processed according to industrial specifications (e.g., DIN 4301) mainly for construction
B1230	Mill scaling arising from the manufacture of iron and steel
B1240	Copper oxide mill-scale
B1250	Waste end-of-life motor vehicles, containing neither liquids nor other hazardous components

Table 6.8. B2 Wastes Containing Principally Inorganic Constituents, which may Contain Metals and Organic Materials

B2010	Wastes from mining operations in non-dispersible form: • Natural graphite waste • Slate waste, whether or not roughly trimmed or merely cut, by sawing or otherwise • Mica waste • Leucite, nepheline and nepheline syenite waste • Feldspar waste • Fluorspar waste • Silica wastes in solid form excluding those used in foundry operations
B2020	Glass waste in non-dispersible form: • Cullet and other waste and scrap of glass except for glass from cathode-ray tubes and other activated glasses
B2030	Ceramic wastes in non-dispersible form: • Cermet wastes and scrap (metal ceramic composites) • Ceramic based fibers not elsewhere specified or included
B2040	Other wastes containing principally inorganic constituents: • Partially refined calcium sulfate produced from flue-gas desulphurization (FGD) • Waste gypsum wallboard or plasterboard arising from the demolition of buildings • Slag from copper production, chemically stabilized, having a high iron content (above 20%) and processed according to industrial specifications (e.g., DIN 4301 and DIN 8201) mainly for construction and abrasive applications • Sulfur in solid form • Limestone from the production of calcium cyanamide (having a pH less than 9) • Sodium, potassium, calcium chlorides • Carborundum (silicon carbide) • Crushed concrete • Lithium-tantalum and lithium-niobium containing glass scraps
B2050	Coal-fired power plant fly-ash, not included on list A (note the related entry on list A A2060)
B2060	Spent activated carbon resulting from the treatment of potable water and processes of the food industry and vitamin production (note the related entry on list A, A4160)
B2070	Calcium fluoride sludge
B2080	Waste gypsum arising from chemical industry processes not included on list A (note the related entry on list A, A2040)
B2090	Waste anode butts from steel or aluminum production made of petroleum coke or bitumen and cleaned to normal industry specifications (excluding anode butts from chlor alkali electrolyses and from metallurgical industry)
B2100	Waste hydrates of aluminum and waste alumina and residues from alumina production excluding such materials used for gas cleaning, flocculation or filtration processes
B2110	Bauxite residue (“red mud”) (pH moderated to less than 11.5)
B2120	Waste acidic or basic solutions with a pH greater than 2 and less than 11.5, which are not corrosive or otherwise hazardous (note the related entry on list A, A4090)

Table 6.9. B3 Wastes Containing Principally Organic Constituents, which may Contain Metals and Inorganic Materials

B3010	Solid plastic waste: The following plastic or mixed plastic materials, provided they are not mixed with other wastes and are prepared to a specification: • Scrap plastic of non-halogenated polymers and co-polymers, including but not limited to the following[13] - ethylene - styrene - polypropylene - polyethylene terephthalate - acrylonitrile - butadiene - polyacetals - polyamides - polybutylene terephthalate - polycarbonates - polyethers - polyphenylene sulfides - acrylic polymers - alkanes C10-C13 (plasticizer) - polyurethane (not containing CFCs) - polysiloxanes - polymethyl methacrylate - polyvinyl alcohol - polyvinyl butyral - polyvinyl acetate • Cured waste resins or condensation products including the following: - urea formaldehyde resins - phenol formaldehyde resins - melamine formaldehyde resins - epoxy resins - alkyd resins - polyamides • The following fluorinated polymer wastes[14] - perfluoroethylene/propylene (FEP) - perfluoro alkoxyl alkane - tetrafluoroethylene/per fluoro vinyl ether (PFA) - tetrafluoroethylene/per fluoro methylvinyl ether (MFA) - polyvinylfluoride (PVF) - polyvinylidenefluoride (PVDF)
B3020	Paper, paperboard and paper product wastes The following materials, provided they are not mixed with hazardous wastes: Waste and scrap of paper or paperboard of: • unbleached paper or paperboard or of corrugated paper or paperboard • other paper or paperboard, made mainly of bleached chemical pulp, not colored in the mass • paper or paperboard made mainly of mechanical pulp (for example,

[13] It is understood that such scraps are completely polymerized.

[14] Post-consumer wastes are excluded from this entry:

- Wastes shall not be mixed
- Problems arising from open-burning practices to be considered

Table 6.9. B3 Wastes Containing Principally Organic Constituents, which may Contain Metals and Inorganic Materials

	newspapers, journals and similar printed matter) • other, including but not limited to 1) laminated paperboard 2) unsorted scrap
B3030	Textile wastes The following materials, provided they are not mixed with other wastes and are prepared to a specification: • Silk waste (including cocoons unsuitable for reeling, yarn waste and garnetted stock) - not carded or combed - other • Waste of wool or of fine or coarse animal hair, including yarn waste but excluding garnetted stock - noils of wool or of fine animal hair - other waste of wool or of fine animal hair - waste of coarse animal hair • Cotton waste (including yarn waste and garnetted stock) - yarn waste (including thread waste) - garnetted stock - other • Flax tow and waste • Tow and waste (including yarn waste and garnetted stock) of true hemp (Cannabis sativa L.) • Tow and waste (including yarn waste and garnetted stock) of jute and other textile based fibers (excluding flax, true hemp and ramie) • Tow and waste (including yarn waste and garnetted stock) of sisal and other textile fibers of the genus Agave • Tow, noils and waste (including yarn waste and garnetted stock) of coconut • Tow, noils and waste (including yarn waste and garnetted stock) of abaca (Manila hemp or Musa textilis Nee) • Tow, noils and waste (including yarn waste and garnetted stock) of ramie and other vegetable textile fibers, not elsewhere specified or included • Waste (including noils, yarn waste and garnetted stock) of man-made fibers - of synthetic fibers - of artificial fibers • Worn clothing and other worn textile articles • Used rags, scrap twine, cordage, rope and cables and worn out articles of twine, cordage, rope or cables of textile materials - sorted - other
B3040	Rubber wastes The following materials, provided they are not mixed with other wastes: • Waste and scrap of hard rubber (e.g., ebonite) • Other rubber wastes (excluding such wastes specified elsewhere)
B3050	Untreated cork and wood waste: • Wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms • Cork waste: crushed, granulated or ground cork
B3060	Wastes arising from agro-food industries provided it is not infectious: • Wine lees • Dried and sterilized vegetable waste, residues and byproducts, whether or not in the form of pellets, of a kind used in animal feeding, not elsewhere specified or included

Table 6.9. B3 Wastes Containing Principally Organic Constituents, which may Contain Metals and Inorganic Materials

	• Degras: residues resulting from the treatment of fatty substances or animal or vegetable waxes • Waste of bones and horn-cores, unworked, defatted, simply prepared (but not cut to shape), treated with acid or degelatinized • Fish waste • Cocoa shells, husks, skins and other cocoa waste • Other wastes from the agro-food industry excluding by-products which meet national and international requirements and standards for human or animal consumption
B3070	The following wastes: • Waste of human hair • Waste straw • Deactivated fungus mycelium from penicillin production to be used as animal feed
B3080	Waste parings and scrap of rubber
B3090	Paring and other wastes of leather or of composition leather not suitable for the manufacture of leather articles, excluding leather sludges, not containing hexavalent chromium compounds and biocides (note the related entry on list A A3100)
B3100	Leather dust, ash, sludges or flours not containing hexavalent chromium compounds or biocides (note the related entry on list A A3090)
B3110	Fellmongery wastes not containing hexavalent chromium compounds or biocides or infectious substances (note the related entry on list A A3110)
B3120	Wastes consisting of food dyes
B3130	Waste polymer ethers and waste non-hazardous monomer ethers incapable of forming peroxides
B3140	Waste pneumatic tires, excluding those destined for the disposal operations in Section A of Table 6.11.

Table 6.10. B4 Wastes which may Contain Either Inorganic or Organic Constituents

B4010	Wastes consisting mainly of water-based/latex paints, inks and hardened varnishes not containing organic solvents, heavy metals or biocides to an extent to render them hazardous (note the related entry on list A A4070)
B4020	Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives, not listed on list A, free of solvents and other contaminants to an extent that they do not exhibit Table 6.1 characteristics, e.g., water-based, or glues based on casein starch, dextrin, cellulose ethers, polyvinyl alcohols (note the related entry on list A A3050)
B4030	Used single-use cameras, with batteries not included on list A

Note: Production waste that is not included as an item in this list:

1. Products that do not comply with specifications
2. Expired products
3. Unusable parts (e.g. spent batteries, spent catalysts)
4. Industrial waste processes (e.g. slag)
5. Waste arising from pollution control operations (e.g. sludge from gas washing equipment, bags used for collecting soot from chimneys and spent air filters)
6. Waste arising from industrial processes and subsequent operations (e.g. lathe waste, grain skin from mills)
7. Waste arising from the processing of raw materials (e.g. mining waste, materials polluted with oil)
8. Fake counterfeit materials (e.g. oils contaminated with polychlorinated biphenyls (PCBs))
9. Unwanted or unusable products (e.g. unwanted commercial, household, agricultural, and commercial products)
10. Materials or products categorized as waste by the producers but are not included in the items listed herewith

Table 6.11. Resource Recovery, Recycling, Reclamation, Direct re-use or Alternative Uses

Section A	Disposal Operations which do not lead to the possibility of resource recovery, recycling, reclamation, direct re-use or alternative uses
D1	Deposit into or onto land, (e.g., landfill, etc.)
D2	Land treatment, (e.g., biodegradation of liquid or sludgy discards in soils, etc.)
D3	Deep injection, (e.g., injection of pumpable discards into wells, salt domes of naturally occurring repositories, etc.)
D4	Surface impoundment, (e.g., placement of liquid or sludge discards into pits, ponds or lagoons, etc.)
D5	Specially engineered landfill, (e.g., placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)
D6	Release into a water body except seas/oceans
D7	Release into seas/oceans including sea-bed insertion
D8	Biological treatment not specified elsewhere in this Table which results in final compounds or mixtures which are discarded by means of any of the operations in this section (Section A)
D9	Physico chemical treatment not specified elsewhere in this Table which results in final compounds or mixtures which are discarded by means of any of the operations in Section A, (e.g., evaporation, drying, calcination, neutralization, precipitation, etc.)
D10	Incineration on land
D11	Incineration at sea
D12	Permanent storage (e.g., emplacement of containers in a mine, etc.)
D13	Blending or mixing prior to submission to any of the operations in this section (Section A)
D14	Repackaging prior to submission to any of the operations in this section (Section A)
D15	Storage pending any of the operations in this section (Section A)
Section B	Operations which may Lead to Resource Recovery, Recycling Reclamation, Direct Re-use or Alternative Uses
R1	Use as a fuel (other than in direct incineration) or other means to generate energy
R2	Solvent reclamation/regeneration
R3	Recycling/reclamation of organic substances which are not used as solvents
R4	Recycling/reclamation of metals and metal compounds
R5	Recycling/reclamation of other inorganic materials
R6	Regeneration of acids or bases
R7	Recovery of components used for pollution abatement
R8	Recovery of components from catalysts
R9	Used oil re-refining or other reuses of previously used oil
R10	Land treatment resulting in benefit to agriculture or ecological improvement
R11	Uses of residual materials obtained from any of the operations numbered R1-R10
R12	Exchange of wastes for submission to any of the operations numbered R1-R11
R13	Accumulation of material intended for any operation in

Note: Section B encompasses all such operations with respect to materials legally defined as or considered to be hazardous wastes and which otherwise would have been destined for operations included in Section A.

Table 6.12. Generator Requirements for the Competent Authority

The following information shall be provided by generators upon notifying Competent Authority of the need to export hazardous waste for disposal:

1. Reason for waste export
2. Exporter of the waste[1]
3. Generator(s) of the waste and site of generation[1]
4. Disposer of the waste and actual site of disposal[1]
5. Intended carrier(s) of the waste or their agents, if known[1]
6. Country of export of the waste
   Competent authority[2]
7. Expected countries of transit
   Competent authority[2]
8. Country of import of the waste
   Competent authority[2]
9. General or single notification
10. Projected date(s) of shipment(s) and period of time over which waste is to be exported and proposed itinerary (including point of entry and exit)[3]
11. Means of transport envisaged (road, rail, sea, air, inland waters)
12. Information relating to insurance[4]
13. Designation and physical description of the waste including Y number and UN number and its composition [5] and information on any special handling requirements including emergency provisions in case of accidents
14. Type of packaging envisaged (e.g. bulk, drummed, tanker)
15. Estimated quantity in weight/volume[6]
16. Process by which the waste is generated[7]
17. For wastes listed in Table 6.2, classifications from Table 6.1: hazardous characteristic, H number, and UN class
18. Method of disposal as per Table 6.11
19. Declaration by the generator and exporter that the information is correct
20. Information transmitted (including technical description of the plant) to the exporter or generator from the disposer of the waste upon which the latter has based his assessment that there was no reason to believe that the wastes will not be managed in an environmentally sound manner in accordance with the laws and regulations of the country of import
21. Information concerning the contract between the exporter and disposer.

Notes

[1] Full name and address, telephone, telex or telefax number and the name, address, telephone, telex or telefax number of the person to be contacted.

[2] Full name and address, telephone, telex or telefax number.

[3] In the case of a general notification covering several shipments, either the expected dates of each shipment or, if this is not known, the expected frequency of the shipments will be required.

[4] Information to be provided on relevant insurance requirements and how they are met by exporter, carrier and disposer.

[5] The nature and the concentration of the most hazardous components, in terms of toxicity and other dangers presented by the waste both in handling and in relation to the proposed disposal method.

[6] In the case of a general notification covering several shipments, both the estimated total quantity and the estimated quantities for each individual shipment will be required.

[7] Insofar as this is necessary to assess the hazard and determine the appropriateness of the proposed disposal operation.

Table 6.13. Information Requirements for Waste Disposal Outside Bahrain

For waste disposed outside of Bahrain, the following information shall be provided:

1. Exporter of the waste[1]
2. Generator(s) of the waste and site of generation[1]
3. Disposer of the waste and actual site of disposal[1]
4. Carrier(s) of the waste[1] or his agent(s)
5. Subject of general or single notification
6. The date the trans boundary movement started and date(s) and signature on receipt by each person who takes charge of the waste
7. Means of transport (road, rail, inland waterway, sea, air) including countries of export, transit and import, also point of entry and exit where these have been designated
8. General description of the waste (physical state, proper UN shipping name and class, UN number, Y number and H number as applicable)
9. Information on special handling requirements including emergency provision in case of accidents
10. Type and number of packages
11. Quantity in weight/volume
12. Declaration by the generator or exporter that the information is correct
13. Declaration by the generator or exporter indicating no objection from the competent authorities of all States concerned which are Parties
14. Certification by disposer of receipt at designated disposal facility and indication of method of disposal and of the approximate date of disposal.

Notes

The information required on the movement document shall where possible be integrated in one document with that required under transport rules. Where this is not possible the information should complement rather than duplicate that required under the transport rules. The movement document shall carry instructions as to who is to provide information and fill-out any form.

[1] Full name and address, telephone, telex or telefax number and the name, address, telephone, telex or telefax number of the person to be contacted in case of emergency.

CHAPTER 7

SOLID WASTE

7.1. SCOPE

This Chapter contains criteria to ensure that solid wastes are identified, classified, collected, transported, stored, treated, and disposed of safely and in a manner protective of human health and the environment. These criteria apply to residential and commercial solid waste generated at the installation level. These criteria are part of integrated waste management. Policies concerning the recycling portion of integrated waste management are found in DoDI 4715.4, "Pollution Prevention", and service solid waste management manuals. The criteria in this Chapter deal with general solid waste. Criteria for specific types of solid waste that require special precautions are provided in Chapter 6, "Hazardous Waste," Chapter 8, "Medical Waste Management," Chapter 11, "Pesticides," and Chapter 14, "Polychlorinated Biphenyls."

7.2. DEFINITIONS

7.2.1. Bulky Waste. Large items of solid waste such as household appliances, furniture, large auto parts, trees, branches, stumps, and other oversize wastes whose large size precludes or complicates their handling by normal solid wastes collection, processing, or disposal methods.

7.2.2. Carry-out Collection. Collection of solid waste from a storage area proximate to the dwelling unit(s) or establishment where generated.

7.2.3. Collection. The act of consolidating solid wastes (or materials that have been separated for the purpose of recycling) from various locations.

7.2.4. Collection Frequency. The number of times collection is provided in a given period of time.

7.2.5. Commercial Solid Waste. All types of solid wastes generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential and industrial wastes**,** that do not contain solvents or degreasing materials, oils, ink, sludge, acids, alkaline, or other non-household materials.

7.2.6. Compactor Collection Vehicle. A vehicle with an enclosed body containing mechanical devices that convey solid waste into the main compartment of the body and compress it into a smaller volume of greater density.

7.2.7. Construction and Demolition Waste. The waste building materials, packaging, and rubble resulting from construction, remodeling, repair and demolition operations on pavements, houses, commercial buildings, and other structures.

7.2.8. Curb Collection. Collection of solid waste placed adjacent to a street.

7.2.9. Cover Material. Material that is used to cover compacted solid wastes in a land disposal site.

7.2.10. Daily Cover. Soil that is spread and compacted or synthetic material that is placed on the top and side slopes of compacted solid waste at least at the end of each operating day to control vectors, fire, moisture, and erosion and to assure an aesthetic appearance. Mature compost or other natural material may be substituted for soil if soil is not reasonably available in the vicinity of the landfill and the substituted material will control vectors, fire, moisture, and erosion and will assure an aesthetic appearance.

7.2.11. Disposal. Processes such as burial, treatment (biological, physical or chemical), permanent storage or incineration**.**

7.2.12. Final Cover. A layer of soil, mature compost, other natural material (or synthetic material with an equivalent minimum permeability) that is applied to the landfill after completion of a cell or trench, including a layer of material that will sustain native vegetation, if any.

7.2.13. Food Waste. The organic residues generated by the handling, storage, sale, preparation, cooking, and serving of foods, commonly called garbage.

7.2.14. Generation. The act or process of producing solid waste.

7.2.15. Hazardous Waste. Refer to Chapter 6, "Hazardous Waste."

7.2.16. Industrial Solid Waste. The solid waste generated by industrial processes and manufacturing.

7.2.17. Inert Waste. Chemically or biologically inactive materials in the natural environment including, but not limited to, glass, building debris, plastic parts, wood, rubber, wires or metal plates as well as uncontaminated soil free of plants.

7.2.18. Institutional Solid Waste. Solid waste generated by educational, health care, correctional, and other institutional facilities, but not including medical waste as defined by Chapter 8.

7.2.19. Land Application Unit. An area where wastes are applied onto or incorporated into the soil surface (excluding manure spreading operations) for agricultural purposes or for treatment or disposal.

7.2.20. Lower Explosive Limit. The lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C (77°F) and atmospheric pressure.

7.2.21. Municipal Solid Waste (MSW). Normally, residential, institutional and commercial solid waste generated within a community, including food waste, but not including yard waste or

hazardous waste as defined in Chapter 6, “Hazardous Waste.” (See also definition in Chapter 2, “Air Emissions.”)

7.2.22. Municipal Solid Waste Landfill (MSWLF) Unit. A discrete area of land or an excavation, on or off an installation, that receives household waste, and that is not a land application unit, surface impoundment, injection well, or waste pile. An MSWLF unit also may receive other types of wastes, such as commercial solid waste and industrial waste.

7.2.23. Open Burning. Burning of solid wastes in the open, such as in an open dump.

7.2.24. Open Dump. A land disposal site at which solid wastes are disposed of in a manner that does not protect the environment, is susceptible to open burning, and is exposed to the elements, vectors, and scavengers.

7.2.25. Residential Solid Waste. The wastes generated by normal household activities, including, but not limited to, food wastes, rubbish, ashes, and bulky wastes.

7.2.26. Rubbish. A general term for solid waste, excluding food wastes and ashes, taken from residences, commercial establishments, and institutions.

7.2.27. Sanitary Landfill. A land disposal site employing an engineered method of disposing of solid wastes on land in a manner that minimizes environmental hazards by spreading the solid wastes in thin layers, compacting the solid wastes to the smallest practical volume, and applying and compacting cover material at the end of each operating day.

7.2.28. Satellite Vehicle. A small collection vehicle that transfers its load into a larger vehicle operating in conjunction with it.

7.2.29. Scavenging. The uncontrolled and unauthorized removal of materials at any point in the solid waste management system.

7.2.30. Service Solid Waste Management Manual. Naval Facility Manual of Operation (NAVFAC MO) 213, Air Force Regulation (AFR) 91-8, Army TM 5-634, Solid Waste Management , or their successor documents.

7.2.31. Sludge. The accumulated semi-liquid suspension of settled solids deposited from wastewaters or other fluids in tanks or basins. It does not include solids or dissolved material in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluent, dissolved materials in irrigation return flows, or other common water pollutants.

7.2.32. Solid Wastes. Garbage, refuse, sludge, and other discarded materials, including solid, semi-solid, liquid, and contained gaseous materials resulting from industrial and commercial operations and from community activities. It does not include solids or dissolved material in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluent, dissolved materials in irrigation return flows, or other common water pollutants.

7.2.33. Solid Waste Storage Container. A receptacle used for the temporary storage of solid waste while awaiting collection.

7.2.34. Stationary Compactor. A powered machine that is designed to compact solid waste or recyclable materials and that remains stationary when in operation.

7.2.35. Storage. The interim containment of solid waste after generation and prior to collection for treatment, ultimate recovery or disposal.

7.2.36. Street Wastes. Material picked up by manual or mechanical sweepings of alleys, streets, and sidewalks; wastes from public waste receptacles; and material removed from catch basins.

7.2.37. Transfer Station. A site at which solid wastes are concentrated for transport to a processing facility or land disposal site. A transfer station may be fixed or mobile.

7.2.38. Vector. A carrier that is capable of transmitting a pathogen from one organism to another.

7.2.39. Yard Waste. Grass and shrubbery clippings, tree limbs, leaves, and similar organic materials commonly generated in residential yard maintenance (also known as green waste).

7.3. CRITERIA

7.3.1. DoD solid wastes will be treated, stored, and disposed of in facilities that have been evaluated against paragraphs 7.3.12., 7.3.14., and 7.3.15. These evaluated facilities will be used to the maximum extent practical.

7.3.2. Installations will cooperate with Bahrain officials, to the extent possible, in the solid waste management planning process.

7.3.3. Installations will develop and implement a solid waste management strategy to reduce solid waste disposal. This strategy could include recycling, composting, and waste minimization efforts.

7.3.4. All solid wastes or materials that have been separated for the purpose of recycling will be stored in such a manner that they do not constitute a fire, health or safety hazard or provide food or harborage for vectors, and will be contained or bundled *and covered* to avoid spillage.

7.3.5. Storage of bulky wastes will include, but will not be limited to, removing all doors from large household appliances and covering the items to reduce both the problems of an attractive nuisance, and the accumulation of solid waste and water in and around the bulky items. Bulky wastes will be screened for the presence of ozone depleting substances as defined in Chapter 2, “Air Emissions,” or hazardous constituents as defined in Chapter 6, “Hazardous

Waste." Readily detachable or removable hazardous waste will be segregated and disposed of in accordance with Chapters 6, 14, and 15 of this Guide.

7.3.6. In the design of all buildings or other facilities that are constructed, modified, or leased after the effective date of this Guide, there will be provisions for storage in accordance with these guidelines that will accommodate the volume of solid waste anticipated. Storage areas will be easily cleaned and maintained, and will allow for safe, efficient collection.

7.3.7. Storage containers should be leak-proof, waterproof, and vermin-proof, including sides, seams and bottoms, and be durable enough to withstand anticipated usage and environmental conditions without rusting, cracking, or deforming in a manner that would impair serviceability. Containers shall be made of either strengthened plastic, galvanized steel, or polyethylene bags and be large enough to collect and contain waste for a period of 24 hours. Storage containers should have functional lids.

7.3.8. Containers should be stored on a firm, level, well-drained surface that is large enough to accommodate all of the containers and that is maintained in a clean, spillage-free condition.

7.3.9. Recycling programs will be instituted on DoD installations in accordance with the policies in DODI 4715.4, "Pollution Prevention".

7.3.10. Installations will not initiate new or expand existing waste landfill units without approval of the Combatant Commander with responsibility for the area where the landfill would be located, and only after justification that unique circumstances mandate a new unit. Consult the Lead Environmental Component (LEC) regarding the location of approved landfill sites.

7.3.11. New DoD MSWLF units will be designed and operated in a manner that incorporates the following broad factors:

7.3.11.1. Location restrictions with regard to airport safety (i.e., bird hazards), floodplains, wetlands, aquifers, seismic zones, unstable areas;

7.3.11.2. Procedures for excluding hazardous waste;

7.3.11.3. Cover material criteria (e.g., daily cover), disease vector control, explosive gas control, air quality criteria (e.g., no open burning), access requirements, liquids restrictions, and record keeping requirements; and

7.3.11.4. Inspection program.

7.3.11.5. Liner and leachate collection system designed consistent with location to prevent groundwater contamination that would adversely affect human health.

7.3.11.6. A groundwater monitoring system unless the installation operating the landfill, after consultation with the LEC, determines that there is no reasonable potential for migration of hazardous constituents from the MSWLF to the uppermost aquifer during the active life of the facility and the post-closure care period.

7.3.12. Installations operating MSWLF units will:

7.3.12.1. Use standard sanitary landfill techniques of spreading and compacting solid wastes and placing daily cover over disposed solid waste at the end of each operating day.

7.3.12.2. Establish criteria for unacceptable wastes based on site-specific factors such as hydrology, chemical and biological characteristics of the waste, available alternative disposal methods, environmental and health effects, and the safety of personnel.

7.3.12.3. Implement a program to detect and prevent the disposal of hazardous wastes, infectious wastes, PCBs, and wastes determined unsuitable for the specific MSWLF unit.

7.3.12.4. Investigate options for composting of MSW as an alternative to landfilling or treatment prior to landfilling.

7.3.12.5. Prohibit open burning, except for infrequent burning of agricultural wastes, silvicultural wastes, land-clearing debris, diseased trees, or debris from emergency clean-up operations.

7.3.12.6. Develop procedures for dealing with yard waste and construction debris that keeps it out of MSWLF units to the maximum extent possible (e.g., composting, recycling).

7.3.12.7. Operate the MSWLF unit in a manner to protect the health and safety of personnel associated with the operation.

7.3.12.8. Maintain conditions that are unfavorable for the harboring, feeding, and breeding of disease vectors.

7.3.12.9. Ensure that methane gas generated by the MSWLF unit does not exceed 25% of the lower explosive limit for methane in structures on or near the MSWLF.

7.3.12.10. Operate in an aesthetically acceptable manner.

7.3.12.11. Operate in a manner to protect aquifers.

7.3.12.12. Control public access to landfill facilities.

7.3.12.13. Prohibit the disposal of bulk or non-containerized liquids if possible.

7.3.12.14. Maintain records on the preceding criteria.

7.3.12.15. During closure and post-closure operations, installations will:

7.3.12.15.1. Install a final cover system that is designed to minimize infiltration and erosion.

7.3.12.15.2. Ensure that the infiltration layer is composed of a minimum of 46 cm (18 inches) of earthen material, geotextiles, or a combination thereof, that have a permeability less than or equal to the permeability of any bottom liner system or natural subsoil present, or a permeability no greater than .00005 cm/sec, whichever is less.

7.3.12.15.3. Ensure that the final layer consists of a minimum of 21 cm (8 inches) of earthen material that is capable of sustaining native plant growth.

7.3.12.15.4. If possible, re-vegetate the final cap with native plants that are compatible with the landfill design, including the liner.

7.3.12.15.5. Prepare a written Closure Plan that includes, at a minimum, a description of the monitoring and maintenance activities required to ensure the integrity of the final cover, a description of the planned uses of the site during the post-closure period, plans for continuing (during the post-closure period) leachate collection, groundwater monitoring, and methane monitoring, and a survey plot showing the exact site location. The plan will be kept as part of the installation's permanent records. The post-closure period will be a minimum of 5 years.

7.3.13. Open burning will not be the regular method of solid waste disposal. Where burning is the method, incinerators meeting air quality requirements of Chapter 2, “Air Emissions,” will be used.

7.3.14. A composting facility that is located on a DoD installation and that processes annually > 5000 tons of sludge from a domestic wastewater treatment plant (see Chapter 4, “Wastewater”) will comply with the following criteria:

7.3.14.1. Operators must maintain a record of the characteristics of the waste composted, sewage sludge, and other materials, such as nutrient or bulking agents being composted, including the source and volume or weight of the material.

7.3.14.1.1. Access to the facility must be controlled. All access points must be secured when the facility is not in operation.

7.3.14.1.2. By-products, including residuals and materials that can be recycled, must be stored to prevent vector intrusion and aesthetic degradation. Materials that are not composted must be removed periodically.

7.3.14.1.3. Run-off water that has come in contact with composted waste, materials stored for composting, or residual waste must be diverted to a leachate collection and treatment system.

7.3.14.1.4. The temperature and retention time for the material being composted must be monitored and recorded.

7.3.14.1.5. Periodic analysis of the compost must be completed for the following parameters: percentage of total solids, volatile solids as a percentage of total solids, pH,

ammonia, nitrate, nitrogen, total phosphorous, cadmium, chromium, copper, lead, nickel, zinc, mercury, and PCBs.

7.3.14.1.6. Compost must be produced by a process to further reduce pathogens. Two such acceptable methods are:

7.3.14.1.6.1. Windrowing, which consists of an unconfined composting process involving periodic aeration and mixing to maintain aerobic conditions during the composting process; and

7.3.14.1.6.2. The enclosed vessel method, which involves mechanical mixing of compost under controlled environmental conditions. The retention time in the vessel must be at least 72 hours with the temperature maintained at 55°C (131°F). A stabilization period of at least 7 days must follow the decomposition period.

7.3.15. Classification and Use of Compost From DoD Composting Facilities. Compost produced at a composting facility that is located on a DoD installation and that processes annually > 5000 tons of sludge from a domestic wastewater treatment plant (see Chapter 4, "Wastewater") must be classified as "Class A" or "Class B" based on the criteria below and, depending on this classification, shall be subject to the restrictions on certain uses.

7.3.15.1. Class A compost must be stored until the compost is matured, i.e., 60 % decomposition has been achieved. Class A compost may contain contaminant levels no greater than the levels indicated below. The compost must be stabilized and contain no greater amounts of inert material than indicated. Allowable average contaminant concentrations in milligrams per kilogram on a dry weight basis are:

PCB	1
Cadmium	10
Chromium	1,000
Copper	500
Lead	500
Mercury	5
Nickel	100
Zinc	1,000

7.3.15.2. Class B compost consists of any compost generated that fails to meet Class A standards.

7.3.15.3. Compost distribution and end use:

7.3.15.3.1. Class A compost may be distributed for unrestricted use, including agricultural applications.

7.3.15.3.2. Class B compost may not be distributed for agricultural applications.

CHAPTER 8

MEDICAL WASTE

8.1. SCOPE

This Chapter contains criteria for the management of medical waste at medical, dental, research and development, and veterinary facilities generated in the diagnosis, treatment, or immunization of human beings or animals or in the production or testing of biologicals subject to certain exclusions. This waste also includes mixtures of medical waste and hazardous waste. It does not apply to what would otherwise be household waste.

8.2. DEFINITIONS

8.2.1. Infectious Agent. Any organism (such as a virus or bacterium) that is capable of being communicated by invasion and multiplication in body tissues and capable of causing disease or adverse health impacts in humans.

8.2.2. Infectious Hazardous Waste. Mixtures of infectious medical waste and hazardous waste to include solid waste such as fluids from a parasitology laboratory.

8.2.3. Infectious Medical Waste. Solid waste produced by medical and dental treatment facilities, nursing, laboratories, research centers, veterinary clinics, and pharmaceutical factories and warehouses, that is specially managed because it has the potential for causing disease in humans and may pose a risk to both individuals or community health if not managed properly, and that includes the following classes:

8.2.3.1. Microbiology waste, including cultures and stocks of etiologic agents which, due to their species, type, virulence, or concentration, are known to cause disease in humans.

8.2.3.2. Pathology waste, including human tissues and organs, amputated limbs or other body parts, fetuses, placentas, and similar tissues from surgery, delivery, or autopsy procedures. Animal carcasses, body parts, blood, and bedding from contaminated animals are also included.

8.2.3.3. Human blood and blood products (including serum, plasma, and other blood components), items contaminated with liquid or semi-liquid blood or blood products and items saturated or dripping with blood or blood products, and items caked with blood or blood products, that are capable of releasing these materials during handling.

8.2.3.4. Potentially infectious materials, including human body fluids such as semen, vaginal secretions, cerebrospinal fluid, pericardial fluid, pleural fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.

8.2.3.5. Sharps, including hypodermic needles, syringes, biopsy needles, and other types of needles used to obtain tissue or fluid specimens, needles used to deliver intravenous solutions, scalpel blades, pasteur pipettes, specimen slides, cover slips, glass petri plates, and broken glass potentially contaminated with infectious waste.

8.2.3.6. Infectious waste from isolation rooms, but only including those items that were contaminated or likely to have been contaminated with infectious agents or pathogens, including excretion exudates and discarded materials contaminated with blood.

8.2.3.7. Contagious, chemical or drug waste.

8.2.3.8. Medical waste contaminated with radioactive material.

8.2.4. Noninfectious Medical Waste. Solid waste created that does not require special management because it has been determined to be incapable of causing disease in humans or which has been treated to render it noninfectious.

8.2.5. Solid Waste. Any solid waste as defined in Chapter 7, “Solid Waste.”

8.2.6. Treatment. Any method, technique, or process designed to change the physical, chemical, or biological character or composition of any infectious hazardous or infectious waste so as to render such waste non-hazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume. Treatment methods for infectious waste must eliminate infectious agents so that they no longer pose a hazard to persons who may be exposed.

8.2.7. Treatment Unit. A facility where the chemical, biological or physical properties of infectious hazardous waste are changed with the use of environmentally-sound technologies with the aim of reducing the hazards of such waste.

8.3. CRITERIA

8.3.1. Infectious medical waste will be separated, if practical, from other solid waste at the point of origin.

8.3.1.1. Medical waste shall be further separated within storage areas. Medical waste shall be segregated into the following categories on a daily basis prior to storage and transport:

8.3.1.1.1. Contagious/infectious waste

8.3.1.1.2. Sharp materials waste

8.3.1.1.3. Chemical drug waste including damaged and expired drugs

8.3.1.1.4. Chemical laboratory waste including chemicals used in laboratories

8.3.1.1.5. Bed item waste including bed-sheets, blankets, containers for receiving the patients secretions not infected with contagious diseases and their intestine waste

8.3.1.1.6. Mortuary and laboratory room waste including clothing, contaminated covers, petri dishes and containers used to deal with biological tissues and bacteria.

8.3.2. Mixtures of infectious medical wastes and hazardous wastes will be handled as infectious hazardous waste under DoD 4160.21-M (Defense Materiel Disposition Manual) and are the responsibility of the generating DoD Component. Priority will be given to the hazard that presents the greatest risk. DLA Disposition Services has no responsibility for this type of property until it is rendered noninfectious as determined by the appropriate DoD medical authority.

8.3.3. Solid waste that is classified as a hazardous waste in accordance with Appendix 1 will be managed in accordance with the criteria in Chapter 6, “Hazardous Waste.”

8.3.4. Mixtures of other solid waste and infectious medical waste will be handled as infectious medical waste.

8.3.5. Radioactive medical waste will be managed in accordance with Service Directives.

8.3.6. Infectious medical waste will be segregated, transported, and stored in bags or receptacles a minimum of 3 mils thick having such durability, puncture resistance, and burst strength as to prevent rupture or leaks during ordinary use.

8.3.6.1. Medical waste shall not be left in bags and containers in the collection area for a period exceeding 24 hours before it is transported outside the health facility.

8.3.7. All bags or receptacles used to segregate, transport or store infectious medical waste will be clearly marked with the universal biohazard symbol and the word "BIOHAZARD" in English and Arabic, and will include markings that identifies the generator, date of generation, and the contents. All medical waste types (Section 8.3.1.), including infectious medical waste, shall be labeled with suitable adhesive cards providing details of their contents, and the hazards associated with their contents. Contact the Lead Environmental Component (LEC) regarding label requirements.

8.3.8. Sharps will only be discarded into rigid receptacles. Needles will not be clipped, cut, bent, or recapped before disposal.

8.3.9. Medical waste will be transported and stored to minimize human exposure and protect the environment. Infectious medical waste, in particular, will not be placed in chutes or dumbwaiters. Consult the LEC regarding additional storage requirements.

8.3.10. Infectious medical waste will not be compacted unless converted to noninfectious medical waste by treatment as described in paragraph 8.3.18. Containers holding sharps will not be compacted.

8.3.11. All anatomical pathology waste (i.e., large body parts) must be placed in containers lined with plastic bags that comply with paragraph C8.3.6., and may only be disposed of in a landfill or by burial in a designated area after being treated for disposal by incineration or cremation.

8.3.12. Blood, blood products, and other liquid infectious wastes will be handled as follows:

8.3.12.1. Bulk blood and blood products may be decanted into a sewer system connection (sinks, drains, etc.), unless pre-treatment is required. If pre-treatment is required, the methods contained in Table 8.1, “Treatment and Disposal Methods for Infectious Medical Waste,” will be employed prior to discharge to the sewer system. The emptied containers will continue to be managed as infectious medical waste.

8.3.12.2. Suction canister waste from operating rooms will either be decanted into a clinical sink or will be sealed into leak-proof containers and incinerated.

8.3.13. All personnel handling infectious medical waste will wear appropriate protective apparel or equipment such as gloves, coveralls, masks, and goggles sufficient to prevent the risk of exposure to infectious agents or pathogens.

8.3.14. If infectious medical waste cannot be treated on-site, it will be managed during storage as follows:

8.3.14.1. Infectious medical waste will be maintained in a nonputrescent state, using refrigeration as necessary.

8.3.14.2. Infectious medical waste with multiple hazards (i.e., infectious hazardous waste or infectious radioactive waste) will be segregated from the general infectious waste stream when additional or alternative treatment is required.

8.3.15. Storage sites must be:

8.3.15.1. Specifically designated;

8.3.15.2. Constructed to prevent entry of insects, rodents, and other pests;

8.3.15.3. Prevent access by unauthorized personnel;

8.3.15.4. Marked on the outside with the universal biohazard symbol and the word "BIOHAZARD" in both English and Arabic.

8.3.16. Generators shall abide by the following conditions prior to transporting medical waste off installation:

8.3.16.1. Ensure safety and soundness of all the bags and containers which contain medical waste. Bags and receptacles containing infectious medical waste, in particular, must be placed into rigid or semi-rigid, leak-proof containers before being transported off-site.

8.3.16.2. Adhesive labels shall be placed on the containers in accordance with Section 8.3.7.

8.3.16.3. Ensure that completed transportation form is turned over with waste to transporter.

8.3.16.4. Prior to waste being transported, ensure the transporter has the proper approval issued by the Competent Authority for transporting medical waste.

8.3.16.5. Ensure that the medical waste treatment unit has been approved by the Competent Authority. If the installation treats their own waste, contact the LEC for approval procedures.

8.3.17. Installations transporting medical waste off installation are required to obtain approval (Section 8.3.22.).

8.3.18. Infectious medical waste must be treated in accordance with Table 8.1, "Treatment and Disposal Methods for Infectious Medical Waste," and the following before disposal:

8.3.18.1. Sterilizers must maintain the temperature at 121°C (250°F) for at least 30 minutes at 103.4 kPa (15 psi).

8.3.18.2. The effectiveness of sterilizers must be checked at least weekly using *Bacillus stearo thermophilus* spore strips or an equivalent biological performance test.

8.3.18.3. Incinerators used to treat medical waste must be designed and operated to maintain a minimum temperature and retention time sufficient to destroy all infectious agents and pathogens and must meet applicable criteria in Chapter 2, "Air Emissions."

8.3.18.4. Ash or residue from the incineration of infectious medical waste must be assessed for classification as hazardous waste in accordance with the criteria in Chapter 6, "Hazardous Waste." Ash that is determined to be hazardous waste must be managed in accordance with Chapter 6. All other residue will be disposed of in a landfill that complies with the criteria of Chapter 7, "Solid Waste."

8.3.18.5. Chemical disinfection must be conducted using procedures and compounds approved by appropriate DoD medical authority for use on any pathogen or infectious agent suspected to be present in the waste.

8.3.18.6. Waste Treatment Units. Installations operating their own waste treatment units for medical waste shall comply with the following requirements:

8.3.18.6.1. Treatment units shall refuse waste if the waste is:

8.3.18.6.1.1. From non-DoD carriers not approved by the Competent Authority

8.3.18.6.1.2. Not accompanied by a duly-completed and signed waste transport form from the producer and carrier or consignment's which do not conform with the details indicated in the form

8.3.18.6.1.3. Of a chemical nature that is not accompanied by their safety details (e.g. Material Safety Data Sheet)

8.3.18.6.2. Waste shall be over packed if the original bag or container is damaged and if temporary storage prior to treatment in the treatment unit is required.

8.3.18.6.3. Dispose of waste and sludge arising from the treatment process at authorized waste disposal sites. Contact the LEC to determine appropriate sites.

8.3.18.6.4. Measure the concentration of the following substances arising from the treatment process:

8.3.18.6.4.1. Emissions to air, on the dates determined by the LEC and according to the standards in Chapter 2, Air Emission

8.3.18.6.4.2. Concentration of contaminants in the industrial discharge water according to the discharge standards in Chapter 4, Wastewater

8.3.18.6.4.3. Concentration of contaminants in sludge and solid waste arising from the waste treatment process on the dates and according to the standards in the waste treatment unit approval, if applicable

8.3.18.6.5. Upon use of incineration technology in waste treatment, a treatment unit shall:

8.3.18.6.5.1. Ensure all chimney emissions to air are colorless and free from heavy smoke at all times

8.3.18.6.5.2. Prohibit the leakage of odors from the emissions produced by the chimney outside the boundaries of the incineration site

8.3.18.6.5.3. Ensure the levels of concentrations emitted into the air shall not exceed the standards in Chapter 2, Air Emissions

8.3.19. Installations will develop contingency plans for treatment or disposal of infectious medical waste should the primary means become inoperable.

8.3.20. Spills of infectious medical waste will be cleaned up as soon as possible in accordance with the following:

8.3.20.1. Response personnel must comply with paragraph 8.3.13.

8.3.20.2. Blood, body fluid, and other infectious fluid spills must be removed with an absorbent material that must then be managed as infectious medical waste.

8.3.20.3. Surfaces contacted by infectious medical waste must be washed with soap and water and chemically decontaminated in accordance with subparagraph C8.3.18.5.

8.3.21. Installations with waste management/treatment units will keep the following records of medical waste disposal for at least three years after the date of disposal:

8.3.21.1. A description of the type and quantity of each waste consignment received, including producer's name, carrier's name, date of hand-over and treatment date

8.3.21.2. A description of the waste produced from the treatment process, its quantity, method and location of disposal

8.3.21.3. Results of the measurements of the concentration of emissions in the air arising from the treatment process

8.3.21.4. Results of the analysis of concentration in sludge and solid waste arising from the treatment process

8.3.21.5. Results of the analysis of the concentration of contaminants in the discharge water arising from the treatment process and released into the sea

8.3.21.6. Waste transportation forms

8.3.22. Installations without waste management/ treatment units shall keep the following records for at least three years after the date of disposal:

8.3.22.1. Type of waste

8.3.22.2. Amount of waste (volume or weight) being transported outside the health facility, date of such transport, and waste carrier's name

8.3.22.3. Treatment, if any, including date of treatment

8.3.22.4. Name of treatment unit

8.3.22.5. Disposition, including date of disposition, and if the waste was transferred to Bahrain facilities, and receipts acknowledging subparagraphs 8.3.22.1. - 8.3.22.3. for each transfer

8.3.22.6. A dedicated register shall be submitted quarterly to the LEC

8.3.23. Medical Waste Approval Installations may require approval to operate a waste treatment unit or transport medical waste. Contact the LEC to determine approval requirements.

Table 8.1. Treatment and Disposal Methods for Infectious Medical Waste

Type of Medical Waste	Method of Treatment	Method of Disposal
Microbiological	[1] Steam sterilization	[2] Municipal solid waste landfill (MSWLF)
	Chemical disinfection	MSWLF
	Incineration	MSWLF
Pathological	[3] Incineration	MSWLF
	[3] Cremation	Burial
	[4] Chemical Sterilization	[5] Domestic wastewater treatment plant (DWTP)
	[4] Steam sterilization	DWTP
Bulk blood & suction canister waste	[6] Steam sterilization Chemical disinfection	DWTP
	[6] Incineration	MSWLF
Sharps in sharps containers	Steam sterilization	MSWLF
	Incineration	MSWLF

Notes

1. Preferred method for cultures and stocks because they can be treated at point of generation
2. See Chapter 7 for criteria for solid waste landfills.
3. Anatomical pathology waste (i.e., large body parts) must be treated either by incineration or cremation prior to disposal.
4. This only applies to placentas, small organs and small body parts which may be steam sterilized or chemically sterilized, ground, and discharged to a domestic wastewater treatment plant.
5. See Chapter 4 for criteria for domestic wastewater treatment plants.
6. Bulk blood or suction canister waste known to be infectious must be treated by incineration or steam sterilization before disposal.

CHAPTER 9

PETROLEUM, OIL, AND LUBRICANTS

9.1. SCOPE

This Chapter contains criteria to control and abate pollution resulting from the storage, transport and distribution of petroleum products. Criteria for underground storage tanks (UST) containing POL or hazardous material products are addressed in Chapter 19, "Underground Storage Tanks." POL spill prevention and response planning criteria are contained in Chapter 18, "Spill Prevention and Response Planning."

9.2. DEFINITIONS

9.2.1. Aboveground Storage Container. POL storage containers, exempt from UST criteria, that are normally placed on or above the surface of the ground. POL storage containers located above the floor and contained in vaults or basements, bunkered containers, and also partially buried containers are considered aboveground storage containers. For the purposes of this Chapter, this includes any mobile or fixed structure, tank, equipment, pipe, or pipeline (other than a vessel or a public vessel) used in oil well drilling operations, oil production, oil refining, oil storage, oil gathering, oil processing, oil transfer, and oil distribution. This also includes equipment in which oil is used as an operating fluid, but excludes equipment in which oil is used solely for motive power.

9.2.2. Below Ground Storage Container. Completely buried POL storage containers, including deferred USTs, that are exempt from all criteria in Chapter 19, "Underground Storage Tanks." For purposes of this paragraph, ONLY below ground storage containers that are exempt from requirements of Chapter 19 are counted toward the aggregate thresholds in subparagraph C9.2.7.2 below.

9.2.3. Loading/ Unloading Racks. Location where tanker trucks/rail cars are loaded and unloaded by pipes, pumps, and loading arms.

9.2.4. Loading/ Unloading Areas. Any location where POL is authorized to be loaded or unloaded to or from a POL storage container.

9.2.5. Pipeline Facility. Includes new and existing pipes, pipeline rights of way, auxiliary equipment (e.g., valves and manifolds), and buildings or other facilities used in the transportation of POL.

9.2.6. POL. Refined petroleum, oils, and lubricants, including, but not limited to, petroleum, fuel, lubricant oils, synthetic oils, mineral oils, animal fats, vegetable oil, sludge, and POL mixed with wastes other than dredged spoil.

9.2.7. POL Facility. An installation with either:

9.2.7.1. An aggregate aboveground storage container capacity (excluding below ground storage containers) of 5,000 liters (1,320 gallons) or greater; or

9.2.7.2. An aggregate below ground storage container capacity of 159,091 liters (42,000 gallons) or greater; or

9.2.7.3. A pipeline facility as identified in the "Pipeline Facility" description

9.2.8. POL Storage Container. POL containers with capacities > 208 liters (55 gallons) (mobile/portable and fixed; and above and below ground storage containers). USTs required to meet all requirements of Chapter 19 are EXCLUDED from the definition of POL storage containers.

9.2.9. Used Oil. Any liquid or semi-solid material which contains entirely or partially metallic or manufactured hydrocarbon oils such as waste oil resulting from maintenance activities of vehicles, engines and other machinery or oil mixed with water produced from a facility or oil used for oiling such engines and other machinery where the original characteristics of oil has been changed during usage. In Bahrain, used oil is only considered hazardous waste if mixed with polychlorinated biphenyls (PCBs) or other hazardous substances (see Chapter 6, "Hazardous Waste.")

9.3. CRITERIA

9.3.1. Applicability. The below criteria, excluding the used oil criteria in Section 9.3.7, apply only at POL Facilities as defined in paragraph 9.2.7. Used oil criteria (9.3.7.) apply for all activities involving used oil.

9.3.2. General POL Storage Container Criteria

9.3.2.1. Inspection and Testing. Inspection and testing shall be conducted on all POL storage containers in accordance with recognized industry standards.

9.3.2.2. Secondary Containment. POL storage containers must be provided with a secondary means of containment (e.g., dike) capable of holding the entire contents of the largest single tank plus sufficient freeboard to allow for precipitation and expansion of product. Alternatively, POL storage containers that are equipped with adequate technical spill and leak prevention options (such as overfill alarms and flow shutoff or restrictor devices) may provide secondary containment by use of a double wall container. Below ground storage containers may meet this criterion by use of a leak barrier with a leak detection pipe and basin. A licensed technical authority may waive this secondary containment criteria for below ground storage containers.

9.3.2.3. Permeability. Permeability for containment areas will be a maximum of 10^{-7} cm/sec.

9.3.2.4. Containment Area Drainage. Drainage of stormwater from containment areas will be controlled by a valve that is locked closed when not in active use. Stormwater will be inspected for petroleum sheen before being drained from containment areas. If a petroleum sheen is present it must be collected with sorbent materials prior to drainage, or treated using an oil-water separator. Disposal of sorbent material exhibiting the hazardous characteristics in Appendix 1 will be in accordance with Chapter 6, "Hazardous Waste."

9.3.2.5. Valves and Piping. All aboveground valves, piping, and appurtenances associated with POL storage containers shall be periodically inspected in accordance with recognized industry standards.

9.3.3. Additional POL Storage Container Criteria

9.3.3.1. Testing. Buried piping associated with POL storage containers shall be tested for integrity and leaks at the time of installation, modification, construction, relocation, or replacement. New buried piping must be protected against corrosion in accordance with recognized industry standards.

9.3.3.2. Storage Container Design. POL storage containers shall be designed or modernized in accordance with good engineering practice to prevent unintentional discharges by use of overflow prevention devices. Chapter 5, "Hazardous Material," includes additional storage design criteria for hazardous chemical substances such as POL.

9.3.3.3. Completely and Partially Buried Metallic POL Storage Containers. These must be protected from corrosion in accordance with recognized industry standards.

9.3.3.4. Additional storage criteria, such as labeling requirements, are included in Chapter 5, "Hazardous Material."

9.3.4. Storage Container Wastes. POL container cleaning wastes frequently have hazardous characteristics (as defined in Appendix 1) and must be handled and disposed of in accordance with requirements of Chapter 6, "Hazardous Waste." POL container waste and handling procedures include:

9.3.4.1. POL container cleaning wastes (sludge and wash waters) must be disposed of in accordance with the criteria of Chapter 6, unless sampling and testing confirms the waste does not exhibit hazardous waste characteristics.

9.3.4.2. POL container bottom waters, which are periodically drained, must be collected and disposed of in accordance with Chapter 6, unless sampling and testing determine that the waste does not exhibit hazardous waste characteristics.

9.3.5. General Transport and Distribution Criteria

9.3.5.1. Loading/Unloading Racks and Areas

9.3.5.1.1. Secondary Containment. Loading/unloading racks shall be designed to handle discharges of at least the maximum capacity of any single compartment of a rail car or tank truck loaded or unloaded at the loading/unloading rack.

9.3.5.1.2. Departing Vehicle Warning Systems. Provide an interlocked warning light or physical barrier system, warning signs, wheel chocks, or vehicle break interlock system at loading/unloading racks to prevent vehicles from departing before complete disconnection of flexible or fixed oil transfer lines.

9.3.5.1.3. Vehicle Inspections. Prior to filling and prior to departure of any tank car or tank truck, closely inspect for discharges from the lowermost drain and all outlets of such vehicles, and if necessary, ensure that they are tightened, adjusted, or replaced to prevent liquid discharge while in transit. In addition, inspectors of the Competent Authority may request external and internal vehicle inspections (e.g., internal pressure levels). Bahrain inspector requests shall be coordinated through the LEC.

9.3.5.1.4. Loading/ Unloading Areas. Provide appropriate containment and/or diversionary structures (dikes, berms, culverts, spill diversion ponds, etc.) or equipment (sorbent materials, wiers, booms, other barriers, etc.) at loading/unloading areas to prevent a discharge of POL, which reasonably could be expected to cause a sheen on waters of the host nation defined in Chapter 4, "Wastewater."

9.3.5.2. POL Pipeline Facilities

9.3.5.2.1. Provisions for Testing and Maintenance. All pipeline facilities carrying POL must be tested and maintained in accordance with recognized industry standards, including:

9.3.5.2.1.1. Each pipeline operator handling POL will prepare and follow a procedural manual for operations, maintenance, and emergencies.

9.3.5.2.1.2. Each new pipeline facility and each facility in which pipe has been replaced or relocated must be tested in accordance with recognized industry standards, without leakage before being placed in service.

9.3.5.2.1.3. All new POL pipeline facilities must be designed and constructed to meet recognized industry construction standards.

9.3.5.3. Additional Transport Requirements. Installations shall comply with the additional hazardous chemical transport requirements included in Section 5.3.12 of Chapter 5, "Hazardous Material" if the POL meets the definition of a hazardous chemical substance in Chapter 5.

9.3.6. Personnel Training. At a minimum, all personnel handling POL shall be trained annually in the operation and maintenance of equipment to prevent discharges; discharge procedure protocols; general facility operations; and the applicable contents of the facility Spill Plan.

9.3.7. Used Oil Management

9.3.7.1. Applicability. The criteria in this sub-paragraph shall apply to all activities which are entirely or partially linked with used oil, including its collection, transport and treatment.

9.3.7.2. Exceptions. Used oil--polychlorinated biphenyls (PCBs) mixtures and any other used oil if designated by the Competent Authority to be dangerous or unsuitable for recycling, are exempt from these requirements. See Chapter 6 for requirements regarding used oil-PCB.

9.3.7.3. Used Oil Generation. Generators of used oil shall comply with the following:

9.3.7.3.1. Soundness of drums/containers used in the transportation of used oil.

9.3.7.3.2. Consignments are accompanied by a transportation form.

9.3.7.3.3. Used oil is not mixed with transformer oil, flammable liquids or any other material which contains halogen-containing compounds or which has been identified specifically by the Competent Authority.

9.3.7.3.4. Used oil transporters and treatment units are approved by the Competent Authority. Approval requirements are the same as for hazardous waste. Installations shall refer to Section 6.3.13. of Chapter 6, “Hazardous Waste.”

9.3.7.3.5. Compliance with transporter duties listed in Section 9.3.7.5. in the case of producer transporting their own used oil.

9.3.7.4. Used Oil Storage Criteria. Used oil shall be loaded into barrels or tankers and stored in designated areas.

9.3.7.5. Used Oil Transportation. Transportation of used oil shall comply with the following transportation requirements:

9.3.7.5.1. Transportation Forms. Used oil consignments shall be accompanied by completed transportation forms (from generators) at all times.

9.3.7.5.2. Used oil shall be packaged in accordance with the provisions of Section 9.3.7.4.

9.3.7.5.3. Used oil shall be kept in separate containers or drums and not mixed with other types of used oil or other substances.

9.3.7.5.4. Consignments shall be compatible with the details included in the transportation form prior to transport.

9.3.7.6. Used Oil Treatment.

9.3.7.6.1. Approval. Used oil treatment units shall submit the details and documents listed in Section 6.3.11. of Chapter 6, "Hazardous Waste," to the Competent Authority via the LEC along with their application for approval.

9.3.7.6.2. Treatment Requirements. Used oil treatment units shall comply with the following requirements:

9.3.7.6.2.1. Ensure that transportation forms signed by the generator accompanies consignments.

9.3.7.6.2.2. Measure the concentration of industrial discharge water arising from the treatment process every three months to ensure compliance with the standards included in Chapter 4, "Wastewater."

9.3.7.6.2.3. Record-keeping. Treatment units shall comply with the record-keeping requirements included in Section 6.3.11. of Chapter 6, "Hazardous Waste."

9.3.8. Approvals. Installations may require approval for the handling of POL classified as hazardous material (see Chapter 5) or hazardous waste (see Chapter 6). Contact the LEC to determine approval requirements.

Chapter 10

Pesticides

10.1. SCOPE

This chapter contains criteria regulating the use, storage, and handling of pesticides, but does not address the use of these materials by individuals acting in an unofficial capacity in a residence or garden. The disposal of pesticides is covered in Chapter 6, "Hazardous Waste," and in Chapter 7, "Solid Waste."

10.2. DEFINITIONS

10.2.1. Certified Pesticide Applicators. Personnel who apply pesticides or supervise the use of pesticides, and who have been formally certified in accordance with DoD 4150.7-M, "DoD Pest Management Training and Certification" (which accepts HN certification in appropriate circumstances).

10.2.2. Hazardous Chemical Substances. Any chemical material with reactive characteristics whether on its own or within a mixture or whether this material is in its original form or manufactured. Classification of hazardous chemical substances is in accordance with the following 8 UN hazard classes:

10.2.2.1. Explosives (Class 1)

10.2.2.2. Compressed or Liquefied Gases (Class 2)

10.2.2.3. Flammable Liquids (Class 3)

10.2.2.4. Flammable Solids (Class 4)

10.2.2.5. Oxidizing Agents (Class 5)

10.2.2.6. Toxic materials (Class 6)

10.2.2.7. Radioactive Materials (Class 7)

10.2.2.8. Corrosive Materials (Class 8)

10.2.3. Integrated Pest Management (IPM). A planned program, incorporating continuous monitoring, education, record-keeping, and communication to prevent pests and disease vectors from causing unacceptable damage to operations, people, property, materiel, or the environment. IPM uses targeted, sustainable (effective, economical, environmentally sound) methods, including education, habitat modification, biological control, genetic control, cultural control,

mechanical control, physical control, regulatory control and, where necessary, the judicious use of least-hazardous pesticides.

10.2.4. Pests. Arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds, undesirable vegetation, and other organisms (except for microorganisms that cause human or animal disease) that adversely affect the wellbeing of humans or animals; attack real property, supplies, equipment or vegetation; or are otherwise undesirable.

10.2.5. Pest Management Consultant. Professional DoD pest management personnel located at component headquarters, field operating agencies, major commands, facilities engineering field divisions or activities, or area support activities who provide technical and management guidance for the conduct of installation pest management operations. Some pest management consultants may be designated by their component as certifying officials.

10.2.6. Pesticide. Any substance or mixture of substances, including biological control agents, that may prevent, destroy, repel, or mitigate pests.

10.2.7. Pesticide Waste. Materials subject to pesticide disposal restrictions including:

10.2.7.1. Any pesticide that has been identified by the pest management consultant as cancelled under U.S. or HN authority;

10.2.7.2. Any pesticide that does not meet specifications, is contaminated, has been improperly mixed, or otherwise unusable, whether concentrated or diluted;

10.2.7.3. Any material used to clean up a pesticide spill; or

10.2.7.4. Any containers, equipment, or material contaminated with pesticides. Empty pesticide containers that have been triple rinsed are NOT considered hazardous waste, and can be disposed of as normal solid waste.

10.2.8. Registered Pesticide. A pesticide that has been registered and approved for sale or use within the United States and Bahrain.

10.3. CRITERIA

10.3.1. All pesticide applications, excluding arthropod skin and clothing repellents, will be recorded using DD Form 1532-1 “Pest Management Maintenance Report,” or a computer-generated equivalent. These records will be archived for permanent retention in accordance with specific service procedures. The Pest Management Maintenance Report has been assigned Report Control Symbol DD-A&T(A&AR)1080 in accordance with DoD 8910-M, “DoD Procedures for Management of Information Requirements.”

10.3.2. Installations will implement and maintain a current pest management plan that includes measures for all installation activities and satellite sites that perform pest control. This

written plan will include IPM procedures for preventing pest problems in order to minimize the use of pesticides. The plan must be reviewed and approved in writing by the appropriate pest management consultant.

10.3.3. All pesticide applications will be made by certified pesticide applicators, with the following exceptions:

10.3.3.1. New DoD employees who are not certified may apply pesticides during an apprenticeship period not to exceed 2 years and only under the supervision of a certified pesticide applicator;

10.3.3.2. Arthropod skin and clothing repellents; and

10.3.3.3. Pesticides applied as part of an installation's self-help program.

10.3.4. All pesticide applicators will be included in a medical surveillance program to monitor the health and safety of persons occupationally exposed to pesticides. Local national personnel shall be monitored in coordination with an approved professional medical clinic.

10.3.5. All pesticide applicators will be provided with personal protective equipment appropriate for the work they perform and the types of pesticides to which they may be exposed. In addition, applicators shall also ensure the use of such equipment when handling chemical pesticides and provide services for its maintenance and cleaning.

10.3.6. Installations will only use registered pesticides that are on the list approved by the Armed Forces Pest Management Board (AFPMB) that have Bahraini approved equivalents (i.e., same manufacturer and same formulations), or Bahraini registered pesticides approved in writing by the appropriate pest management consultant. This may be documented as part of the approval of the pest management plan.

10.3.7. Pesticides will be included in the installation spill contingency plan. (See Chapter 18, "Spill Prevention and Response Planning.")

10.3.8. Pest management facilities, including mixing and storage areas, will comply with AFPMB Technical Guide 17 "Military Handbook Design of Pest Management Facilities" and with relevant requirements included in Chapter 5 of this Guide which shall apply for the handling and use of chemical pesticides in Bahrain.

10.3.9. All pesticide applications will be in accordance with guidance given on the pesticide label. Labels will bear the appropriate use instructions and precautionary message based on the toxicity category of the pesticide ("danger," "warning," or "caution"). If foreign nationals will be using the pesticides, the precautionary messages and use instructions will be in English and in Arabic. Chemical pesticide labels shall additionally comply with the labeling requirements for hazardous chemical substances which are included in Chapter 5 of this Guide.

10.3.10. MSDSs and labels for all pesticides will be available at the storage and holding facility, in accordance with Chapter 5 of this Guide, "Hazardous Material."

10.3.11. Pesticide storage areas will contain a readily-visible current inventory of all items in storage, including items awaiting disposal, and should be regularly inspected and secured to prevent unauthorized access.

10.3.12. Unless otherwise restricted or canceled, pesticides in excess of installation needs will be redistributed within the supply system or disposed of in accordance with procedures outlined below:

10.3.12.1. The generator of pesticide wastes will determine whether or not the waste is hazardous, in accordance with Chapter 6 of this Guide.

10.3.12.2. Pesticide waste determined to be hazardous waste will be disposed of in accordance with the criteria for hazardous waste disposal in Chapter 6 of this Guide.

10.3.12.3. Pesticide waste that is determined not to be a hazardous waste will be disposed of in accordance with the label instructions, through DLA-DS, as a solid waste. Pesticide containers shall be crushed or the top and bottom portions shall be removed to prevent reuse.

CHAPTER 11

HISTORIC & CULTURAL RESOURCES

11.1. SCOPE

This Chapter contains criteria for required plans and programs needed to ensure proper protection and management of cultural resources, such as properties on the World Heritage List or on the Bahraini list equivalent to the U.S. National Register of Historic Places.

11.2. DEFINITIONS

11.2.1. Adverse Effect. Changes that diminish the quality or significant value of historic or cultural resources.

11.2.2. Archeological Resource. Any material remains of prehistoric or historic human life or activities. Such resources include, but are not limited to: pottery, basketry, bottles, weapons, weapon projectiles, tools, structures or portions of structures, pit houses, rock paintings, rock carvings, intaglios, graves, human skeletal remains, or any portion of any of the foregoing items.

11.2.3. Cultural Mitigation. Specific steps designed to lessen the adverse effects of a DoD action on a historical or cultural resource, including:

11.2.3.1. Limiting the magnitude of the action

11.2.3.2. Relocating the action in whole or in part

11.2.3.3. Repairing, rehabilitating, or restoring the affected resources, affected property; and

11.2.3.4. Recovering and recording data from cultural properties that may be destroyed or substantially altered

11.2.4. Historic and Cultural Resources Program. Identification, evaluation, documentation, curation, acquisition, protection, rehabilitation, restoration, management, stabilization, maintenance, recording, and reconstruction of historic and cultural resources and any combination of the foregoing.

11.2.5. Historic or Cultural Resources. Physical remains of any prehistoric or historic district, site, building, structure, or object significant in world, national or local history, architecture, archeology, engineering, or culture. The term includes artifacts, archeological resources, records, and material remains that are related to such a district, site, building, structure, or object, and also includes natural resources (plants, animals, landscape features, etc.) that may be considered important as a part of a country’s traditional culture and history. The

term also includes any property listed on the World Heritage List or the Bahraini equivalent of the National Register of Historic Places. Bahraini lists of properties should be evaluated to determine if they are equivalent with the National Register of Historic Places prior to application.

11.2.6. Inventory. To determine the location of historic and cultural resources that may have world, national, or local significance.

11.2.7. Material Remains. Physical evidence of human habitation, occupation, use, or activity, including the site, loci, or context in which such evidence is situated including:

11.2.7.1. Surface or subsurface structures

11.2.7.2. Surface or subsurface artifact concentrations or scatters

11.2.7.3. Whole or fragmentary tools, implements, containers, weapons, clothing, and ornaments

11.2.7.4. By-products, waste products, or debris resulting from manufacture or use

11.2.7.5. Organic waste

11.2.7.6. Human remains

11.2.7.7. Rock carvings, rock paintings, and intaglios

11.2.7.8. Rock shelters and caves

11.2.7.9. All portions of shipwrecks; or

11.2.7.10. Any portion or piece of any of the foregoing

11.2.8. Preservation. The act or process of applying measures to sustain the existing form, integrity, and material of a building or structure, and the existing form and vegetative cover of a site. It may include initial stabilization work where necessary, as well as ongoing maintenance of the historic building materials.

11.2.9. Protection. The act or process of applying measures designed to affect the physical condition of a property by safeguarding it from deterioration, loss, attack, or alteration, or to cover or shield the property from danger or injury. In the case of buildings and structures, such treatment is generally temporary and anticipates future historic preservation treatment; in the case of archaeological sites, the protective measure may be temporary or permanent.

11.3. CRITERIA

11.3.1. U.S. installation commanders shall take into account the effect of any action on any property listed on the World Heritage List or on Bahrain's equivalent of the National Register of Historic Places for purposes of avoiding or mitigating any adverse effects.

11.3.2. Installations shall have access to the World Heritage List and the Bahraini equivalent of the National Register of Historic Places. Contact the LEC for Bahraini equivalent.

11.3.3. U.S. installation commanders shall ensure that personnel performing historic or cultural resource functions have the requisite expertise in world, national, and local history and culture. This may be in-house, contract, or through consultation with another agency. Government personnel directing such functions must have training in historic or cultural resources management.

11.3.4. Installations shall, after coordination with the Bahraini installation commander or similar appropriate Bahraini authorities, prepare, maintain, and implement a cultural resources management plan that contains information needed to make appropriate decisions about cultural and historic resources identified on the installation inventory, and for mitigation of any adverse effects.

11.3.5. Installations shall, after coordination with the Bahraini installation commander or similar appropriate Bahraini authorities, and if financially and otherwise practical:

11.3.5.1. Inventory historic and cultural resources in areas under DoD control. An inventory shall be developed from a records search and visual survey.

11.3.5.2. Establish measures sufficient to protect known historic or cultural resources until appropriate mitigation or preservation can be completed.

11.3.5.3. Establish measures sufficient to protect known archeological resources until appropriate mitigation or preservation can be completed.

11.3.6. U.S. installation commanders shall establish measures to prevent DoD personnel from disturbing or removing historic or cultural resources without permission of the host nation.

11.3.7. U.S. Installation Commanders shall ensure that planning for major actions includes consideration of possible effects on historic or cultural resources.

11.3.7.1. Installations shall submit an application for the evaluation of the environmental impact of a major action to the Lead Environmental Component (LEC). If required, the LEC will notify the installation whether an environmental evaluation impact report and environmental approval is required. The installation should obtain environmental approval, if required, through the LEC, and should also consult the LEC prior to conducting environmental evaluations. Installations shall employ specialized consulting firms approved by the Competent Authority, or those with sufficient experience in the field of specialization as supported by relevant

documentation, to conduct studies and analyses as part of the environmental evaluation impact report.

11.3.7.2. Approved installations shall maintain a register listing the effects of major actions on the environment for a period of ten years. Bahraini inspector requests to examine these registers should be coordinated through the LEC.

11.3.8. If potential historic or cultural resources not previously inventoried are discovered in the course of a DoD action, the newly discovered items will be preserved and protected pending a decision on final disposition by the installation commander. The decision on final disposition will be made by the installation commander after coordination with the Bahraini installation commander or similar appropriate Bahraini authorities.

11.3.8.1. Consult the LEC prior to providing information to the Bahraini Base Commander/Competent Authority.

Chapter 12

Natural Resources and Endangered Species

12.1. SCOPE

This Chapter establishes criteria for required plans and programs needed to ensure proper protection, enhancement, and management of natural resources and any species (flora or fauna) declared endangered or threatened by either the U.S. or Bahrain governments.

12.2. DEFINITIONS

12.2.1. Adverse Effect. Changes that diminish the quality or significant value of natural resources. For biological resources, adverse effects include significant decreases in overall population diversity, abundance, and fitness.

12.2.2. Conservation. Planned management, use, and protection; continued benefit for present and future generations; and prevention of exploitation, destruction, and/or neglect of natural resources.

12.2.3. Bahrain-Protected Species. Any species of flora or fauna listed or designated by Bahrain, because continued existence of the species is, or is likely to be, threatened, and is therefore subject to special protection from destruction or adverse modification of associated habitat.

12.2.4. Management Plan. A document describing natural resources, their quantity, condition, and actions to ensure their conservation and good stewardship.

12.2.5. Natural Resources. All living and inanimate materials supplied by nature that are of aesthetic, ecological, educational, historical, recreational, scientific, or other value.

12.2.6. Natural Resources Management. Actions taken that combine science, economics, and policy, to study, manage, and restore natural resources to strike a balance with the needs of people and the ability of the ecosystem to support soil, water, forest, fish, wildlife, and coastal resources.

12.2.7. Significant Land or Water Area. Land or water area that is normally 202 hectares (500 acres) or more outside the cantonment area; areas of smaller size are included if they have natural resources that are especially vulnerable to disturbance.

12.2.8. Threatened and Endangered Species. Any species of fauna or flora, listed in Table 12.1. This also includes any species of fauna or flora listed on an equivalent Bahrain protected species list.

12.3. CRITERIA

12.3.1. Installations that have land and water areas shall take reasonable steps to protect and enhance known endangered or threatened species and Bahrain-protected species and their habitat.

12.3.2. Installations shall maintain, or have access to, Table 12.1, "Select Endangered and Threatened Species," as well as a current list of Bahrain-protected species, if applicable, and Table 13.2, "List of Bahrain Protected Areas."

12.3.3. Installations with significant land or water areas shall, after coordination with the Bahrain installation commander or-LEC, develop natural resources management plans.

12.3.4. Installations with natural resources management plans shall, after coordination with the Bahrain installation commander or LEC, and if financially and otherwise practical, and in such a way that there is no net loss of mission capability:

12.3.4.1. Conduct a survey to determine the presence of any threatened or endangered species or Bahrain-protected species, or support Bahrain surveys.

12.3.4.2. Implement natural resources management plans

12.3.5. An environmental evaluation impact report and approval may be required for certain types of projects. Consult the LEC regarding project approval requirements. Only approved specialized consulting firms shall be utilized to conduct studies and analyses as part of an environmental evaluation impact report. Installations shall maintain environmental evaluation impact reports for ten years.

12.3.6. The LEC and Bahrain installation commander or, if there is no Bahrain installation commander, the U.S. Ambassador will be notified of the discovery of any endangered or threatened species and Bahrain-protected species not previously known to be present on the installation.

12.3.7. Installations shall maintain grounds to meet designated mission use and ensure harmony with the natural landscape and/or the adjacent Bahrain facilities where practical.

12.3.8. Installations shall ensure that personnel performing natural resource functions have the requisite expertise in the management of their discipline (i.e., endangered or threatened species, Bahraini -protected species, wetlands, soil stabilization). This may be in-house, contract, or through consultation with another agency. Government personnel directing such functions must have training in natural resources management.

12.3.9. Installations shall place emphasis on the maintenance and protection of habitats favorable to the reproduction and survival of indigenous flora and fauna.

12.3.10. Land and vegetative management activities will be consistent with current conservation and land use principles (e.g., ecosystem protection, biodiversity conservation, and mission-integrated land use).

12.3.11. Installations shall utilize protective vegetative cover or other standard soil erosion/sediment control practices to control dust, stabilize sites, and avoid silting of streams.

Table 12.1. Select Endangered & Threatened Species

Common Name	Scientific Name	OCONUS Country of Listing
FAUNA		
Mammals		
Cheetah	*Acinonyx jubatus*	Africa to India
Dugong	*Dugong dugon*	East Africa to southern Japan, including U.S.A. (Trust Territories)
Gazelle, sand	*Gazella subgutturosa marica*	Jordan, Arabian Peninsula
Gazelle, Saudi Arabian	*Gazella dorcas saudiya*	Israel, Iraq, Jordan, Syria, Arabian Peninsula
Oryx, Arabian	*Oryx, leucoryx*	Arabian Peninsula
Dolphin	*Not specified*	Bahrain
Birds		
Bulbul, White-Cheeked	*Pycnonotus leucogenys*	Bahrain
Bustards, Houbara	*Chlamydotis undulate*	Bahrain
Falcon, Eurasian peregrine	*Falco peregrinus peregrinus*	Europe, Eurasia south to Africa and Mideast
Ibis, northern bald	*Geronticus eremita*	Southern Europe
Reptiles		
Crocodile, Nile	*Crocodylus niloticus*	Africa, Middle East
Monitor, desert	*Varanus griseus*	North Africa to Aral Sea, through Central Asia to Pakistan, Northwest India
Sea turtle, green	*Chelonia mydas*	circumglobal in tropical and temperate seas and oceans
Sea turtle, loggerhead	*Caretta caretta*	Circumglobal in tropical and temperate seas and oceans
Sea turtle, olive ridley	*Lepidochelys olivacea*	Circumglobal in tropical and temperate seas
Crustaceans		
Shrimp	Not specified	Bahrain
Lobster	Not specified	Bahrain
Fish		
Rabbit Fish	*Siganus (genus)*	Bahrain
FLORA		
Palm tree	Not specified	Bahrain

Note: This table does not include a complete list of Bahraini-designated threatened and endangered species. The Competent Authority shall be consulted as needed regarding the determination of additional threatened, protected or endangered species in Bahrain.

Table 12.2. List of Bahrain Protected Areas

Protected Area	**Area Type**
Hawar islands and waters	Archipelago
Toubli Bay	Inshore coastal area
Al Areen Wildlife Park and Reserve	Terrestrial protected area
Mashtan Island	Offshore island
Douha Araad	Sheltered bay

Chapter 13

Polychlorinated Biphenyls

13.1. SCOPE

This Chapter contains criteria to control and abate threats to human health and the environment from the handling, use, storage, and disposal of polychlorinated biphenyls (PCB). These criteria include specific requirements for most uses of PCBs, including, but not limited to, transformers, capacitors, heat transfer systems, hydraulic systems, electromagnets, switches and voltage regulators, circuit breakers, reclosers, and cables.

13.2. DEFINITIONS

13.2.1. Capacitor - A device for accumulating and holding a charge of electricity and consisting of conducting surfaces separated by a dielectric.

13.2.2. Chemical Waste Landfill - A landfill at which a high level of protection against risk of injury to human health or the environment from migration of deposited PCBs to land, water, or the atmosphere is provided by incorporating special methods for locating, engineering, and operating the landfill.

13.2.3. Hazardous Chemical Substances - Any chemical material with reactive characteristics whether on its own or within a mixture or whether this material is in its original form or manufactured. Classification of hazardous chemical substances is in accordance with the following 8 UN hazard classes:

13.2.3.1. Explosives (Class 1)

13.2.3.2. Compressed or Liquefied Gases (Class 2)

13.2.3.3. Flammable Liquids (Class 3)

13.2.3.4. Flammable Solids (Class 4)

13.2.3.5. Oxidizing Agents (Class 5)

13.2.3.6. Toxic materials (Class 6)

13.2.3.7. Radioactive Materials (Class 7)

13.2.3.8. Corrosive Materials (Class 8)

13.2.4. In or Near Commercial Buildings - Within the interior of, on the roof of, attached to the exterior wall of, in the parking area serving, or within 30 meters (98.43 feet) of a non-industrial, non-substation building.

13.2.5. Incinerator - An engineered device using controlled-flame combustion to thermally degrade PCBs and PCB items. Examples include rotary kilns, liquid injection incinerators, cement kilns, and high temperature boilers.

13.2.6. Leak or Leaking - Any instance in which a PCB article, PCB container, or PCB equipment has any PCBs on any portion of its external surface.

13.2.7. Mark - The descriptive name, instructions, cautions, or other information applied to PCBs and PCB items, or other objects subject to this Guide.

13.2.8. Marked - PCB items and PCB storage areas and transport vehicles marked by applying a legible mark by painting, fixation of an adhesive label, or by any other method that meets these criteria.

13.2.9. Non-PCB Transformers - Any transformer that contains < 50 ppm PCB.

13.2.10. PCB Article - Any manufactured article, other than a PCB container, that contains PCBs and whose surface(s) has been in direct contact with PCB. This includes capacitors, transformers, electric motors, pumps, and pipes.

13.2.11. PCB Article Container - Any package, can, bottle, bag, barrel, drum, tank, or other device used to contain PCB articles or PCB equipment, and whose surface(s) has not been in direct contact with PCBs.

13.2.12. PCB Container - Any package, can, bottle, bag, barrel, drum, tank, or other device that contains PCBs or PCB articles, and whose surface(s) has been in direct contact with PCBs.

13.2.13. PCB-Contaminated Electrical Equipment - Any electrical equipment including, but not limited to, transformers, capacitors, circuit breakers, reclosers, voltage regulators, switches, electromagnets, and cable, that contain 50 ppm or greater PCB, but < 500 ppm PCB.

13.2.14. PCB Equipment - Any manufactured item, other than a PCB container or a PCB article container, which contains a PCB article or other PCB equipment, and includes microwave ovens, electronic equipment, and fluorescent light ballasts and fixtures.

13.2.15. PCB Item - Any PCB article, PCB article container, PCB container, or PCB equipment that deliberately or unintentionally contains or has as a part of it any PCB, or PCBs at a concentration of 50 ppm or greater.

13.2.16. PCB Transformer - Any transformer that contains 500 ppm PCB or greater.

13.2.17. Restricted Access Area - Areas where access by unauthorized personnel is controlled by fences, other man-made structures, or naturally occurring barriers such as mountains, cliffs, or rough terrain.

13.2.18. Substantial Contact Area - An area that is subject to public access on a routine basis or which could result in substantial dermal contact by employees.

13.2.19. PCB Large High Voltage Capacitor - A capacitor that contains 1.36 kg (3 lbs.) or more of dielectric fluid and which operates at 2,000 volts (alternating current (ac) or direct current (dc)) or above.

13.2.20. PCB Large Low Voltage Capacitor - A capacitor that contains 1.36 kg (3 lbs.) or more of dielectric fluid and which operates below 2,000 volts (ac or dc).

13.3. CRITERIA

13.3.1. General

13.3.1.1. The installation spill contingency plan will address PCB items, including temporary storage items. Chapter 18, “Spill Prevention and Response Planning,” provides criteria on how to prepare these plans.

13.3.1.2. Spills of PCB liquids at concentrations of 50 ppm or greater will be responded to immediately upon discovery and cleaned up in accordance with the following:

13.3.1.2.1. Surfaces that are located in substantial contact areas will be cleaned to 10 micrograms (μg) per 100 square centimeters (cm^2).

13.3.1.2.2. Surfaces in all other contact areas will be cleaned to 100 μg per 100 cm^2.

13.3.1.2.3. Contaminated soil located in restricted access areas will be removed until the soil tests no higher than 25 ppm PCBs and will be backfilled with clean soil containing < 1 ppm PCBs. Restricted access areas in which PCB spills have been cleaned up shall have annotated on installation real property records the level of PCBs remaining in the soil, including the extent, date and type of sampling, and a reference to any reports documenting the site conditions.

13.3.1.2.4. Contaminated soil located in unrestricted access areas will be removed to a minimum depth of *25.4 cm* (10 inches) or until the soil tests no higher than 10 ppm PCBs, whichever is deeper, and will be backfilled with clean soil containing < 1 ppm PCBs.

13.3.1.3. All PCB transformers, PCB large high voltage capacitors, PCB containers, and certain PCB items containing PCBs at concentrations 50 ppm or greater (i.e., electric motors using PCB coolants, hydraulic systems using PCB hydraulic fluid, and heat transfer systems using PCBs), as well as any PCB article containers used to store the preceding items, must be prominently marked in English and Arabic. The marking must identify the item as containing

PCBs, warn against improper disposal and handling, and provide a phone number in case of spills or if questions arise about disposal. This marking criteria also applies to rooms, vaults, and storage areas containing PCB transformers or storing PCBs or PCB items for disposal**.** Storage containers for PCB-contaminated oil shall comply with container requirements included in Chapter 6, "Hazardous Wastes" as PCB-contaminated oil is considered to be hazardous waste. In addition, the following PCB items must be marked at the time of items' removal from use if not already marked: PCB large low voltage capacitors and equipment containing a PCB transformer or PCB large high voltage capacitor.

13.3.1.4. Each installation having PCB items will maintain a written inventory that includes a current list by type of all marked PCB items in use and PCB items (whether or not marked) placed into storage for disposal or disposed of for that year. Inventory records should be maintained for a period of time at least 3 years after disposal of the last item on the list.

13.3.1.5. Disposal of PCB items will only be through the servicing DLA-DS in accordance with DoD 4160.21-M, "Defense Demilitarization Manual" or paragraph 13.3.5 of this Guide.

13.3.1.6. All periodic inspections as required in this Chapter will be documented at the installation. Records of inspections and maintenance history will be maintained for three years after disposal of the transformer.

13.3.2. PCB Transformers (500 ppm PCB or greater)

13.3.2.1. PCB transformers that are in use or in storage for reuse will not be used in any application that poses a risk of contamination to food or feed.

13.3.2.2. All PCB transformers, including those in storage for reuse, will be registered with the servicing fire department.

13.3.2.3. PCB transformers in use in or near commercial buildings or located in sidewalk vaults will be equipped with electrical protection to minimize transformer failure that would result in the release of PCBs.

13.3.2.4. PCB transformers removed and stored for reuse will only be returned to their original application and location and will not be used at another location unless there is no practical alternative; and any such alternative use will not exceed one year.

13.3.2.5. PCB transformers will be serviced as follows:

13.3.2.5.1. Transformers classified as PCB-contaminated electrical equipment will only be serviced with dielectric fluid containing < 500 ppm PCB;

13.3.2.5.2. Any servicing of PCB transformers requiring removal of the transformer coil is prohibited;

13.3.2.5.3. PCBs removed during servicing will be captured and either reused as dielectric fluid or disposed of in accordance with paragraph 14.3.5;

13.3.2.5.4. PCB transformers may be serviced with dielectric fluid at any PCB concentration. However, the dielectric fluid from a PCB transformer will not be mixed with the dielectric fluid from PCB-contaminated electrical equipment;

13.3.2.5.5. Regardless of PCB concentration, dielectric fluids containing < 500 ppm PCBs that are mixed with fluids containing ≥ 500 ppm PCBs will not be used as dielectric fluid in any electrical equipment. The entire mixture must be considered to be > 500 ppm PCBs; and

13.3.2.5.6. Dielectric fluids containing ≥ 500 ppm PCBs will not be used as dielectric fluid in any transformers classified as PCB-contaminated electrical equipment.

13.3.2.6. All in-service PCB transformers (> 500 ppm) will be inspected at least every 3 months except that PCB transformers with impervious, undrained secondary containment capacity of 100 % of dielectric fluid or PCB transformers tested and found to contain < 60,000 ppm PCBs will be inspected at least every 12 months.

13.3.2.7. If any PCB transformer is involved in a fire and was subjected to heat and/or pressure sufficient to result in violent or nonviolent rupture, the installation will take measures to control water runoff, such as blocking floor drains. Runoff water will be tested and treated if required.

13.3.2.8. Leaking PCB transformers shall be repaired or replaced within 48 hours or as soon as possible after discovery of the leak. Leaking PCB transformers not repaired or replaced will be inspected daily. Leaking PCB fluid will be containerized.

13.3.2.9. All transformers will be considered and treated as PCB transformers unless information to the contrary exists.

13.3.3. Other PCB Items

13.3.3.1. Electromagnets, switches, and voltage regulators that may contain PCBs at any concentration are serviced as follows:

13.3.3.1.1. PCB-contaminated electrical equipment will only be serviced with dielectric fluid containing < 500 ppm PCB;

13.3.3.1.2. Servicing any electromagnet, switch, or voltage regulator with a PCB concentration of ≥ 500 ppm that requires the removal and rework of the internal components is prohibited;

13.3.3.1.3. PCBs removed during servicing will be captured and either reused as dielectric fluid or disposed of properly;

13.3.3.1.4. PCBs from electromagnets, switches, and voltage regulators with a PCB concentration of 500 ppm or greater will not be mixed with or added to dielectric fluid from PCB-contaminated electrical equipment; and

13.3.3.1.5. Dielectric fluids containing ≥ 500 ppm will not be used as dielectric fluid in any electromagnet, switch, or voltage regulator classified as PCB-contaminated electrical equipment.

13.3.3.2. Capacitors containing PCBs at any concentration must be managed as follows:

13.3.3.2.1. Use and storage for reuse of PCB large high-voltage capacitors and PCB large low-voltage capacitors that pose an exposure risk to food or feed is prohibited;

13.3.3.2.2. Use of PCB large high-voltage and PCB large low-voltage capacitors is prohibited unless the capacitor is used within a restricted-access electrical substation or in a contained and restricted-access indoor installation. The indoor installation will not have public access and will have an adequate roof, walls, and floor to contain any release of PCBs; and

13.3.3.3. Any PCB item removed from service will be marked with the date it is removed from service.

13.3.4. Storage

13.3.4.1. PCBs and PCB items at concentrations ≥ 50 ppm that are to be stored before disposal will be stored in a facility that will assure the containment of PCBs, including:

13.3.4.1.1. Roofs and walls of storage buildings that exclude rainfall;

13.3.4.1.2. A containment berm, at least 15.24 cm (6 inches) high, sufficient to contain twice the internal volume of the largest PCB article, or 25 % of the total internal volume of all PCB articles or containers stored, whichever is greater;

13.3.4.1.3. Drains, valves, floor drains, expansion joints, sewer lines, or other openings constructed to prevent any release from the bermed area;

13.3.4.1.4. Continuous, smooth, and impervious flooring material; and

13.3.4.1.5. To the maximum extent possible, a new PCB storage area will be located to minimize the risk of release due to seismic activity, floods, or other natural events. For facilities located where there is a high possibility of such risks, the installation spill prevention and control plan will address the risk.

13.3.4.1.6. Compliance with additional hazardous chemical storage requirements (see Chapter 5).

13.3.4.2. The following items may be stored temporarily in an area, subject to weekly inspection, that does not comply with the above requirements for up to 30 days from the date of removal from service:

13.3.4.2.1. Non-leaking PCB items, marked to indicate whether it is a PCB article or PCB equipment;

13.3.4.2.2. Leaking PCB articles and PCB equipment placed in a non-leaking PCB container that contains sufficient absorbent material to absorb fluid contained in the PCB article or equipment;

13.3.4.2.3. PCB containers in which non-liquid PCBs have been placed; and

13.3.4.2.4. PCB containers in which PCBs at a concentration between 50-499 ppm have been placed, and whose containers are marked to indicate there is < 500 ppm PCB.

13.3.4.3. Non-leaking and structurally undamaged large high-voltage PCB capacitors and PCB-contaminated electric equipment that have not been drained of free-flowing dielectric fluid may be stored on pallets, or raised platforms, next to a storage area meeting the criteria of paragraph 14.3.4. if they are inspected weekly.

13.3.4.4. All other PCB storage areas will be inspected at least monthly.

13.3.4.5. Containers used for the storage of PCBs will be at least as secure as those required for their transport for disposal by the servicing DLA-DS. In addition, PCB storage containers shall also comply with the criteria for hazardous chemical substance containers included in Chapter 5 of this guide.

13.3.5. Disposal. PCB wastes are considered to be hazardous waste and shall be disposed of in accordance with the requirements of Chapter 6, “Hazardous Waste.” In addition, installations shall also comply with the following disposal requirements for specific PCB waste products:

13.3.5.1. Installations that generate PCB waste of ≥ 50 ppm PCB will maintain an audit trail for the wastes at least as stringent as that required under the criteria in Chapter 6, “Hazardous Waste.” Installations will coordinate with the LEC to obtain host nation concurrence for in-country PCB disposal as for HW disposal.

13.3.5.2. PCB-contaminated dielectric fluid with concentrations > 500 ppm will only be disposed in an incinerator with 99.9 % combustion efficiency.

13.3.5.3. PCB-contaminated dielectric fluid with concentrations ≥ 50 ppm, but < 500 ppm, will only be disposed as follows:

13.3.5.3.1. In an incinerator with 99.9 % combustion efficiency; or

13.3.5.3.2. In a high-efficiency boiler that is rated at a minimum of 14.65 W (50 MBtu/hr) and is fueled by natural gas, oil, or coal.

13.3.5.4. Rags, soil, and other debris with PCBs at concentrations of ≥ 50 ppm will be disposed of:

13.3.5.4.1. In an incinerator with 99.9 %combustion efficiency; or

13.3.5.4.2. In a chemical waste landfill.

13.3.5.5. PCB transformers will be disposed of:

13.3.5.5.1. In an incinerator with 99.9 % combustion efficiency; or

13.3.5.5.2. In a chemical waste landfill, provided the transformers, and all their inner workings, are first drained of all free-flowing liquids.

13.3.5.6. PCB capacitors will be disposed of as follows:

13.3.5.6.1. PCB capacitors will be disposed of in an incinerator with 99.9 % combustion efficiency, except,

13.3.5.6.2. Intact non-leaking small PCB capacitors may be disposed of in a solid waste landfill unless large quantities (more than 45.36 kg (100 pounds)) are identified at the same time.

13.3.5.7. PCB hydraulic machines containing PCBs may be disposed of as municipal solid waste if:

13.3.5.7.1. The machines containing PCBs at concentrations of 50 ppm or greater are drained of all free-flowing liquid.

13.3.5.7.2. The machines containing PCB liquid of ≥1,000 ppm are flushed prior to disposal with a solvent containing < 50 ppm PCB.

13.3.5.8. PCB-contaminated electrical equipment, except capacitors, will be disposed of as municipal solid waste only after draining all free-flowing liquid.

13.3.5.9. PCB articles, other than those already described, will be disposed of:

13.3.5.9.1. In an incinerator with 99.9 % combustion efficiency; or

13.3.5.9.2. In a chemical waste landfill, provided the articles are first drained of all free-flowing liquids.

13.3.5.10. PCB containers with concentrations of ≥ 500 ppm may be disposed of:

13.3.5.10.1. In an incinerator with 99.9 % combustion efficiency; or

13.3.5.10.2. In a chemical waste landfill, provided the containers are first drained of all free-flowing liquids.

13.3.5.11. Where PCB fluids, items, or articles are disposed of in a high-temperature boiler, the following procedures will be followed:

13.3.5.11.1. The boiler must be rated at a minimum of 14.65 MW hours (50 million BTU hours);

13.3.5.11.2. If the boiler uses natural gas or oil as the primary fuel, the carbon monoxide concentration in the stack must be ≤ 50 ppm and the excess oxygen is at least 3 % when PCBs are being burned;

13.3.5.11.3. If the boiler uses coal as the primary fuel, the carbon monoxide concentration in the stack is ≤ 100 ppm and the excess oxygen is at least 3 % when PCBs are being burned;

13.3.5.11.4. The mineral oil dielectric fluid does not comprise more than 10 %, by volume, of the total fuel feed rate;

13.3.5.11.5. The mineral oil dielectric fluid is not fed into the boiler unless the boiler is operating at its normal operating temperature and is not fed during start up or shut down operations;

13.3.5.11.6. The performance of the boiler is continuously monitored for carbon monoxide and excess oxygen percentage in the stack gas while burning mineral oil dielectric fluid or, for boilers burning < 112,500 liters (30,000 gallons) of mineral oil dielectric fluid per year, monitoring is performed at least every 60 minutes;

13.3.5.11.7. The primary fuel feed rates, mineral oil dielectric fluid feed rates, and the total quantities of both primary fuel and mineral oil dielectric fluid fed to the boiler are measured and recorded at least every 15 minutes; and

13.3.5.11.8. The flow of mineral oil dielectric fluid is stopped if the criteria respecting carbon monoxide or excess oxygen are exceeded.

13.3.5.12. Where PCB fluids, items or articles are disposed of in an incinerator, the following procedures will be followed:

13.3.5.12.1. Combustion criteria shall maintain the introduced liquids for a 2-second dwell time at 1,200°C, plus or minus 100°C (2,200°F +/- 212°F), and 3 % excess oxygen in the stack gas or maintenance of the introduced liquids for a 1-1/2 second dwell time at 1,600°C, plus or minus 100°C (3,050°F +/- 212°F) and 2 % excess oxygen in the stack gas;

13.3.5.12.2. Combustion efficiency, measured by the ratio of the concentration of carbon dioxide to the total concentration of both carbon dioxide and carbon monoxide, will be maintained at least 99.9 %;

13.3.5.12.3. The rate and quantity of PCBs that are fed to the combustion system shall be measured and recorded at regular intervals not > 15 minutes;

13.3.5.12.4. The temperatures of the incineration process shall be continuously measured and recorded;

13.3.5.12.5. The flow of PCBs to the incinerator shall stop automatically if temperature criteria are not met;

13.3.5.12.6. Monitoring is conducted sufficient to determine that an incinerator to be used for disposal the first time will operate within the criteria above; and

13.3.5.12.7. Continuous monitoring is conducted during incineration of PCBs for oxygen and carbon monoxide and periodic monitoring for carbon dioxide.

13.3.5.13. PCB containers used to contain only PCBs at a concentration < 500 ppm may be disposed of as municipal solid waste only after draining all free-flowing liquid.

13.3.5.14. Retrogrades of PCB Items. DoD-generated PCB items manufactured in the United States will be returned to the United States for delivery to a permitted disposal facility if host country or third country disposal is not possible, is prohibited, or would not be managed in an environmentally sound manner. Ensure that all PCB items and equipment are marked in accordance with criteria in subparagraph 13.3.1.3.

13.3.6. Elimination of PCB Products

13.3.6.1. Installations shall minimize the use of PCBs and PCB items without degrading mission performance.

13.3.6.2. Installations shall not purchase or otherwise take control of PCBs or PCB items for use.

13.3.6.3. All procurement of transformers or any other equipment containing dielectric or hydraulic fluid shall be accompanied by a manufacturer’s certification that the equipment contains no detectable PCBs (< 2 ppm) at the time of shipment.

13.3.6.4. Such newly procured transformers and equipment shall have permanent labels affixed stating they are PCB-free (no detectable PCBs).

Chapter 14

Asbestos

14.1. SCOPE

This Chapter contains criteria to control and abate threats to human health and the environment from asbestos, and describes management of asbestos during removal and disposal. Policy requirements for a comprehensive Occupational Health and Safety program are not covered in this Chapter. To protect personnel from asbestos exposure, refer to DoDI 6055.1, "DoD Safety and Occupational Health (SOH) Program" and DoDI 6055.5, "Industrial Hygiene and Occupational Health" and concomitant service instructions.

14.2. DEFINITIONS

14.2.1. Adequately Wet. Sufficiently mix or penetrate with liquid to prevent the release of particulates. If visible emissions coming from ACM are observed, then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wet.

14.2.2. Asbestos. Generic term used to describe six distinctive varieties of fibrous mineral silicates, including chrysotile, amosite, crocidolite, tremolite asbestos, anthrophylite asbestos, actinolite asbestos, and any other of these materials that have been chemically treated and/or altered.

14.2.3. Asbestos-Containing Material (ACM). Any material containing > 1% asbestos by weight.

14.2.4. Friable Asbestos. Any material containing > 1% asbestos that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

14.2.5. Category I Nonfriable ACM. Means asbestos containing packings, gaskets, resilient floor covering, and asphalt roofing products containing > 1% asbestos.

14.2.6. Category II Nonfriable ACM. Means any material, excluding Category I nonfriable ACM, containing > 1% asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

14.2.7. Regulated ACM. Means (a) Friable asbestos material, (b) Category I nonfriable ACM that has become friable, (c) Category I nonfriable ACM that will be or has been subjected to sanding grinding, cutting, or abrading, or (d) Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.

14.3. CRITERIA. Installations shall contact the LEC to determine approval requirements for activities involving the handling, removal or disturbance of asbestos.

14.3.1. Installations will appoint an asbestos program manager to serve as the single point of contact for all asbestos-related activities.

14.3.2. Installations will prepare and implement an asbestos management plan. As a minimum, the plan will include the following:

14.3.2.1. An ACM inventory, conducted by sample and analysis or visual determination;

14.3.2.2. A notification and education program to tell workers, tenants, and building occupants where potentially friable ACM is located, and how and why to avoid disturbing the ACM; all persons affected should be properly informed;

14.3.2.3. Regular ACM surveillance to note, assess, and document any changes in the ACM's condition;

14.3.2.4. Work control/permit systems to control activities that might disturb ACM including;

14.3.2.4.1. Work Control. Barriers and/or markers to warn personnel of asbestos areas and preventing unauthorized access.

14.3.2.5. Operations and maintenance (O&M) work practices to avoid or minimize fiber release during activities affecting ACM such as daily maintenance of equipment and materials to clear asbestos particles and dust;

14.3.2.6. Record keeping to document O&M activities related to asbestos identification management and abatement;

14.3.2.7. Training for the asbestos program manager as well as custodial and maintenance staff;

14.3.2.8. Procedures to assess and prioritize identified hazards for abatement; and

14.3.2.9. Procedures to prevent the use of ACM in new construction.

14.3.2.10. Requirement for importers to provide customs with a certificate proving the asbestos-free nature of their products, if required and if importing suspect asbestos-containing materials.

14.3.3. Prior to demolition or renovation of a facility, the installation will make a determination whether or not the activity will remove or disturb ACM, and will record this determination on the project authorization document (e.g., work order).

14.3.4. Prior to demolition or renovation of a facility that involves removing or disturbing friable ACM, a written assessment of the action will be prepared and furnished to the installation commander. A copy of the assessment will also be kept on permanent file.

14.3.5. Installations will remove friable ACM when the ACM poses a threat to release airborne asbestos fibers and cannot be reliably repaired or isolated.

14.3.6. Before disturbing or demolishing a facility or part of a facility, installations will remove all regulated ACM.

14.3.7. When disposing of asbestos waste, installations will adequately wet all ACM waste, seal it in a leak-proof container, and properly dispose of it in an MSWLF as defined in Chapter 7, “Solid Waste.” Containers will be labeled in English and Arabic: "DANGER - CONTAINS ASBESTOS FIBERS - AVOID CREATING DUST - CANCER AND LUNG DISEASE HAZARD." Permanent records documenting the disposal action and site will be maintained. Asbestos dust and fiber waste are considered to be hazardous wastes and shall be disposed of in accordance with the provisions in Chapter 6 of this Guide.

14.3.8. DoD schools will comply with applicable requirements of 15 U.S.C. 2643(l) and implementing regulations in 40 CFR Part 763, Subpart E, “Asbestos-Containing Materials in Schools.”

CHAPTER 15

LEAD-BASED PAINT

15.1. SCOPE

This Chapter contains criteria to establish and implement a lead hazard management program to identify, control, or eliminate lead-based paint hazards, through interim controls or abatement, in child-occupied facilities and military family housing, in a manner protective of human health and the environment. Policy requirements for a comprehensive Occupational Health and Safety program are not covered in this Chapter. To protect personnel from lead exposure, refer to DoDI 6055.1, "DoD Safety and Occupational Health", DoDI 6055.5, "Industrial Hygiene and Occupational Health", and concomitant service instructions.

15.2. DEFINITIONS

15.2.1. Abatement. Any set of measures designed to permanently eliminate lead-based paint or lead-based paint hazards. Abatement includes the removal of lead-based paint and lead contaminated dust, the permanent enclosure or encapsulation of lead-based paint, the replacement of components or fixtures painted with lead-based paint, and the removal or covering of lead-contaminated soil. Abatement also includes all preparation, cleanup, disposal, and post-abatement clearance activities associated with such measures.

15.2.2. Accessible Surface. An interior or exterior surface painted with lead-based paint that is accessible for a young child to mouth or chew.

15.2.3. Bare Soil. Soil, including sand, not covered by grass, sod, or other live ground covers, or by wood chips, gravel, artificial turf, or similar covering.

15.2.4. Child-Occupied Facility. A facility, or portion of a facility, visited regularly by the same child, 6 years of age or under, on at least two different days within any week, provided that each days' visit lasts at least 3 hours and the combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours. Child-occupied facilities may include, but are not limited to, day-care centers, preschools, playgrounds, and kindergarten classrooms.

15.2.5. Clearance. Visual evaluation and testing (collection and analysis of environmental samples) conducted after lead-based paint hazard reduction activities, interim controls, and standard treatments to determine that the work is complete and no lead-contaminated bare soil or lead-contaminated settled dust exist in a facility frequented by children under the age of 6.

15.2.6. Deteriorated Paint. Any interior or exterior paint or other coating that is peeling, chipping, chalking, cracking, or is otherwise damaged or separated from the substrate.

15.2.7. Elevated Blood Lead Level. A confirmed concentration of lead in whole blood of 20 μg/dl (micrograms of lead per deciliter) for a single test, or 15-19 μg/dl in two tests taken at least 3 months apart.

15.2.8. Encapsulation. The application of any covering or coating that acts as a barrier between the lead-based paint and the environment. Encapsulation may be used as a method of abatement if it is designed to be permanent.

15.2.9. Enclosure. The use of rigid, durable construction materials that are mechanically fastened to the substrate to act as a barrier between lead-based paint and the environment. Enclosure may be used as a method of abatement if it is designed to be permanent.

15.2.10. Evaluation. A visual evaluation, risk assessment, risk assessment screen, paint inspection, paint testing, or a combination of risk assessment and paint inspection to determine the presence of deteriorated paint, lead-based paint, or a lead-based paint hazard.

15.2.11. Friction Surface. An interior or exterior surface that is subject to abrasion or friction, including but not limited to, window, floor, and stair surfaces.

15.2.12. Hazardous Chemical Substances. Any chemical material with reactive characteristics whether on its own or within a mixture or whether this material is in its original form or manufactured. Classification of hazardous chemical substances is in accordance with the following 8 UN hazard classes:

15.2.12.1. Explosives (Class 1)

15.2.12.2. Compressed or Liquefied Gases (Class 2)

15.2.12.3. Flammable Liquids (Class 3)

15.2.12.4. Flammable Solids (Class 4)

15.2.12.5. Oxidizing Agents (Class 5)

15.2.12.6. Toxic materials (Class 6)

15.2.12.7. Radioactive Materials (Class 7)

15.2.12.8. Corrosive Materials (Class 8)

15.2.13. Hazard Reduction. Measures designed to reduce or eliminate human exposure to lead-based paint hazards through various methods, including interim controls or abatement or a combination of the two.

15.2.14. Impact Surface. An interior or exterior surface that is subject to damage by repeated sudden force, such as certain parts of doorframes.

15.2.15. Interim Controls. A set of measures designed to temporarily reduce human exposure or likely exposure to lead-based paint hazards. Interim controls include, but are not limited to, repairs, occasional and ongoing maintenance, painting, temporary containment, specialized cleaning, clearance, ongoing activities, and the establishment and operation of management and resident education programs.

15.2.16. Lead-Based Paint. Paint or other surface coatings that contain lead equal to or exceeding 1.0 milligram per cm^2, or 0.5 % by weight or 5,000 ppm by weight.

15.2.17. Lead-Based Paint Hazard includes paint-lead-hazard, dust-lead hazard or soil-lead hazard as identified below:

15.2.17.1. Paint-lead hazard. A paint-lead hazard is any of the following:

15.2.17.1. Any lead-based paint on a friction surface that is subject to abrasion and where the lead dust levels on the nearest horizontal surface underneath the friction surface (e.g., the window sill, or floor) are equal to or greater than the dust-lead hazard levels identified in the definition for dust-lead hazard (previously defined as lead-contaminated dust) – see below.

15.2.17.2. Any damaged or otherwise deteriorated lead-based paint on an impact surface that is caused by impact from a related building component (such as a doorknob that knocks into a wall or a door that knocks against its doorframe).

15.2.17.3. Any chewable lead-based painted surface on which there is evidence of teeth marks.

15.2.17.4. Any other deteriorated lead-based paint in any residential building or child-occupied facility or on the exterior of any residential building or child-occupied facility.

15.2.17.2. Dust-lead hazard (previously defined as lead-contaminated dust). Surface dust in a residential dwelling or child-occupied facility that contains a mass-per-area concentration of lead equal to or exceeding 40 $\mu g/ft^2$ on floors or 250 $\mu g/ft^2$ on interior window sills based on wipe samples.

15.2.17.3. Soil-lead hazard (previously defined as lead-contaminated soil). Bare soil on residential real property or on the property of a child-occupied facility that contains total lead equal to or exceeding 400 ppm ($\mu g/g$) in a play area, or an average of 1,200 ppm of bare soil in the rest of the yard based on soil samples.

15.2.18. Lead-Based Paint Inspection. A surface-by-surface investigation to determine the presence of lead-based paint, and the provision of a report explaining the results of the investigation.

15.2.19. Permanent. An expected design life of at least 20 years.

15.2.20. Reevaluation. A visual evaluation of painted surfaces and limited dust and soil sampling conducted periodically following lead-based paint hazard reduction where lead-based paint is still present.

15.2.21. Replacement. A strategy of abatement that entails removing building components that have surfaces coated with lead-based paint (such as windows, doors, and trim) and installing new components free of lead-based paint.

15.2.22. Risk Assessment. An on-site investigation to determine the existence, nature, severity, and location of lead-based paint hazards and the provision of a report explaining the results of the investigation and options for reducing lead-based paint hazards.

15.2.23. Risk Assessment Screen. A sampling protocol that is used in dwellings that are in relatively good condition and where the probability of finding lead-based hazards are low. The protocol involves inspecting such dwellings and collecting samples from representative locations on the floor, interior window sills, and window troughs to determine whether conducting a risk assessment is warranted.

15.3. CRITERIA

15.3.1. Installations will:

15.3.1.1. Develop and implement a multi-disciplinary lead-based paint hazard management program to identify, evaluate, and reduce lead-based paint hazards in child-occupied facilities and military family housing.

15.3.1.2. Manage identified lead-based paint hazards through interim controls or abatement. In addition, new projects or major alterations to existing projects which involve lead-based paints will utilize the best available technology to prevent or control pollution to reduce the risk of environmental deterioration.

15.3.1.3. Identify lead-based paint hazards in child-occupied facilities and military family housing using any or all of the following methods:

15.3.1.3.1. Lead-based paint risk assessment screen. If screen identifies dust-lead levels >25 µg/ft$_2$ for floors, >125 µg/ft^2 for interior window sills, a lead-based paint risk assessment should be performed.

15.3.1.3.2. Lead-based paint risk assessments.

15.3.1.3.3. Routine facility inspection for fire and safety.

15.3.1.3.4. Occupant, facility manager, and worker reports of deteriorated paint.

15.3.1.3.5. Results of childhood blood lead screening or reports of children identified to have elevated blood lead levels.

15.3.1.3.6. Lead-based paint reevaluations.

15.3.1.3.7. Review of construction, painting, and maintenance histories.

15.3.1.4. Ensure occupants and worker protection measures are taken during all maintenance, repair, and renovation activities that disturb areas known or assumed to have lead-based paint.

15.3.1.5. Disclose the presence of any known lead-based paint or lead-based paint hazards to occupants of child-occupied facilities and military family housing and provide information on lead-based paint hazard reduction. In addition, inform occupants of military family housing, prior to conducting remodeling or renovation projects, of the hazards associated with these activities, and provide information on protecting family members from the hazards of lead-based paint.

15.3.1.6. Ensure that all personnel involved in lead-based activities, including paint inspection, risk assessment, specification or design, supervision, and abatement, are properly trained.

15.3.1.7. Dispose of lead-contaminated waste that meets the definition of a hazardous waste in accordance with Chapter 6, “Hazardous Waste,” paragraph 6.2.5.

CHAPTER 16

SPILL PREVENTION AND RESPONSE PLANNING

16.1. SCOPE

This Chapter contains criteria to plan for, prevent, control, and report spills of POL and hazardous substances. It is DoD policy to prevent spills of these substances due to DoD activities and to provide for prompt, coordinated response to contain and clean up spills that might occur. Remediation beyond that required for the initial response is conducted pursuant to DoDI 4715.8 (Environmental Remediation for DoD Activities Overseas).

16.2. DEFINITIONS

16.2.1. Aboveground Storage Container. POL storage containers, exempt from UST criteria, that are normally placed on or above the surface of the ground. POL storage containers located above the floor and contained in vaults or basements, bunkered containers, and also partially buried containers are considered aboveground storage containers. For the purposes of this Chapter, this includes any mobile or fixed structure, tank, equipment, pipe, or pipeline (other than a vessel or a public vessel) used in oil well drilling operations, oil production, oil refining, oil storage, oil gathering, oil processing, oil transfer, and oil distribution. This also includes equipment in which oil is used as an operating fluid but excludes equipment in which oil is used solely for motive power.

16.2.2. Decontamination Wastes. Waste materials generated during the decontamination of equipment and personnel used during spill response including but not limited to purging water, rinsing water, plastic containers, rags, gloves, and other personal protective equipment.

16.2.3. Hazardous Substance. Any substance having the potential to do serious harm to human health or the environment if spilled or released in reportable quantity. A list of these substances and the corresponding reportable quantities is contained in Appendix 1, "Characteristics of Hazardous Waste and Lists of Hazardous Waste and Hazardous Material." Hazardous substances do not include:

16.2.3.1. Petroleum, including crude POL or any fraction thereof, that is not otherwise specifically listed or designated as a hazardous substance above.

16.2.3.2. Natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

16.2.3.3. Classification of hazardous substances is in accordance with the following hazard classes:

16.2.3.3.1. Explosives (Class 1)

16.2.3.3.2. Compressed or Liquefied Gases (Class 2)

16.2.3.3.3. Flammable Liquids (Class 3)

16.2.3.3.4. Flammable Solids (Class 4)

16.2.3.3.5. Oxidizing Agents (Class 5)

16.2.3.3.6. Toxic Materials (Class 6)

16.2.3.3.7. Radioactive Materials (Class 7)

16.2.3.3.8. Corrosive Materials (Class 8)

16.2.4. Facility Incident Commander (FIC) (previously known as the Installation On-scene Coordinator). The official who coordinates and directs DoD control and cleanup efforts at the scene of a POL or hazardous substance spill due to DoD activities on or near the installation. This official is designated by the installation commander.

16.2.5. Facility Response Team (FRT) (previously known as the Installation Response Team). A team performing emergency functions as defined and directed by the FIC.

16.2.6. Oil. Oil of any kind or in any form, including, but not limited to, petroleum, fuel POL, lube oils, animal fats, vegetable oil, sludge, POL refuse, and POL mixed with wastes other than dredged spoil.

16.2.7. POL. Refined petroleum, oils, and lubricants. (See also definition in Chapter 9, "Petroleum, Oil, and Lubricants.")

16.2.8. Significant Spill. An uncontained release to the land or water in excess of any of the following quantities:

16.2.8.1. For hazardous wastes or hazardous substances identified as a result of inclusion in Table AP 1.T4., "List of Hazardous Waste/Substances/Materials," any quantity in excess of the reportable quantity listed in that table;

16.2.8.2. For POL or liquid or semi-liquid hazardous material, hazardous waste or hazardous substances, in excess of 400 liters (110 gallons);

16.2.8.3. For other solid hazardous material in excess of 225 Kg (500 pounds);

16.2.8.4. For combinations of POL and liquid, semi-liquid, and solid hazardous materials, hazardous waste or hazardous substance, in excess of 340 Kg (750 pounds); or

16.2.8.5. If a spill is contained inside an impervious berm, or on a nonporous surface, or inside a building and is not volatilized and is cleaned up, the spill is considered a contained release and is not considered a significant spill.

16.2.9. Worst Case Discharge. The largest foreseeable discharge from the facility, under adverse weather conditions, as determined using as a guide the worst case discharge planning volume criteria in Appendix 2, "Determination of Worst Case Discharge Planning Volume."

16.3. CRITERIA

16.3.1. Spill Prevention Control and Reporting Plan Requirement. All DoD installations will prepare, maintain, and implement a Spill Prevention and Response Plan, which provides for the prevention, control, and reporting of all spills of POL and hazardous substances. The plan will provide measures to prevent, and to the maximum extent practicable, to remove a worst case discharge from the facility. The plan should be kept in a location easily accessible to the FIC and FRT with an updated copy available in close proximity to, but not in, the storage areas, in the case of hazardous chemical substance spill.

16.3.1.1. The plan will be updated at least every 5 years or:

16.3.1.1.1. Within 6 months of any significant changes to operations.

16.3.1.1.2. When there have been two significant spills to navigable waters in any 12-month period;

16.3.1.1.3. When there has been a spill of 3,785 liters (1,000 gallons) or greater.

16.3.1.2. The plan shall be certified by an appropriately licensed or certified technical authority ensuring that the plan considers applicable industry standards for spill prevention and environmental protection, that the plan is prepared in accordance with good engineering practice, and is adequate for the facility. Technical changes (i.e., non-administrative) to the plan require recertification. The plan shall be submitted to the LEC who shall determine requirement to provide to Bahrain authorities.

16.3.2. Prevention Section. The prevention section of the plan will, at a minimum, contain the following:

16.3.2.1. Name, title, responsibilities, duties, and telephone number of the designated FIC and an alternate.

16.3.2.2. General information on the installation including name, type or function, location and address, charts of drainage patterns, designated water protection areas, maps showing locations of facilities described in subparagraph 18.3.2.3, critical water resources, land uses, and possible migration pathways.

16.3.2.3. An inventory of storage, handling, and transfer sites that could possibly produce a significant spill. For each listing, using maps as appropriate, a prediction of the direction and rate of flow should be included, as well as the total quantity of POL or hazardous substances that might be spilled as a result of a major failure and the types of dangers associated with hazardous chemical substances in every part of the storage site.

16.3.2.4. An inventory of all POL and hazardous substances at storage, handling, and transfer facilities described in subparagraph 18.3.2.3. A list of locations of the hazardous chemical substances, along with their associated dangers, shall also be provided.

16.3.2.5. Procedures for the periodic integrity testing of all aboveground storage containers, including visual inspection and where deemed appropriate, another form of nondestructive testing. The frequency and type of inspection and testing must take into account container size and design (floating/fixed roof, skid-mounted, elevated, cut-and cover, partially buried, vaulted above-ground, etc.) and industry standards.

16.3.2.6. Procedures for periodic inspection for all above ground valves, piping, and appurtenances associated with POL storage containers, in accordance with Chapter 9, "Petroleum, Oil, and Lubricants," subparagraph 9.3.2.5.

16.3.2.7. Arrangements for Emergency Services. The plan will describe arrangements with installation and/or local police departments, fire departments, hospitals, contractors, and emergency response teams to coordinate emergency services.

16.3.2.8. Means to Contact Emergency Services. The plan will include a telephone number or other means to contact the appropriate emergency service provider (e.g., installation fire department) on a 24-hour basis.

16.3.2.9. A detailed description of the facility's prevention, control, and countermeasures, including structures and equipment for diversion and containment of spills, for each site listed in the inventory. Measures should permit, as far as practical, reclamation of spilled substances. Chapters governing hazardous materials, hazardous waste, POL, underground storage tanks, pesticides, and PCBs provide specific criteria for containment structure requirements.

16.3.2.10. When secondary containment is not feasible for any container listed in the inventory, the plan shall include a detailed explanation of measures that will be taken to prevent spills (e.g., pre-booming, integrity testing, frequent inspection), as determined by the licensed or certified technical authority.

16.3.2.11. A list of all emergency equipment (such as fire extinguishing systems, spill control equipment, communications and alarm systems (internal and external), and decontamination equipment) at each site listed in the inventory where this equipment is required. This list will be kept up-to-date. In addition, the plan will include the location and a physical description of each item on the list, and a brief outline of its capabilities.

16.3.2.12. An evacuation plan for each site listed in the inventory, where there is a possibility that evacuation would be necessary. This plan will describe signal(s) to be used to begin evacuation, evacuation routes, alternate evacuation routes (in cases where the primary routes could be blocked by releases of hazardous waste or fires), and a designated meeting place.

16.3.2.13. A description of deficiencies in spill prevention and control measures at each site listed in the inventory, to include corrective measures required, procedures to be followed to

correct listed deficiencies and any interim control measures in place. Corrective actions must be implemented within 24 months of the date of plan preparation or revision.

16.3.2.14. Written procedures for:

16.3.2.14.1. Operations to preclude spills of POLs and hazardous substances;

16.3.2.14.2. Inspections; and

16.3.2.14.3. Record keeping requirements.

16.3.2.15. Site-specific procedures should be maintained at each site on the facility where significant spills could occur.

16.3.3. Spill Control Section. The control section of the plan (which may be considered a contingency plan) will identify resources for cleaning up spills at installations and activities, and to provide assistance to other agencies when requested. At a minimum, this section of the plan will contain:

16.3.3.1. Provisions specifying the responsibilities, duties, procedures, and resources to be used to contain and clean up spills.

16.3.3.2. A description of immediate response actions that should be taken when a spill is first discovered.

16.3.3.3. The responsibilities, composition, and training requirements of the FRT.

16.3.3.4. The command structure that will be established to manage a worst case discharge. Include an organization chart and the responsibilities and composition of the organization.

16.3.3.5. Procedures for FRT alert and response to include provisions for:

16.3.3.5.1. Access to a reliable communications system for timely notification of a POL spill or hazardous substance spill.

16.3.3.5.2. Public affairs involvement.

16.3.3.6. A current roster of the persons, and alternates, who must receive notice of a POL or hazardous substance spill, including a Defense Energy Support Center (DESC) representative if applicable. The roster will include name, organization mailing address, and work and home telephone number. Without compromising security, the plan will include provisions for the notification of the emergency coordinator after normal working hours.

16.3.3.7. The plan will provide for notification of the FIC, installation commander, and local authorities in the event of hazard to human health or environment.

16.3.3.8. Assignment of responsibilities for making the necessary notifications, including notification to the emergency services providers.

16.3.3.9. Surveillance procedures for early detection of POL and hazardous substance spills.

16.3.3.10. A prioritized list of various critical water and natural resources that will be protected in the event of a spill.

16.3.3.11. Other resources addressed in prearranged agreements that are available to the installation to cleanup or reclaim a large spill due to DoD activities, if such spill exceeds the response capability of the installation.

16.3.3.12. Cleanup methods, including procedures and techniques used to identify, contain, disperse, reclaim, and remove POL and hazardous substances used in bulk quantity on the installation.

16.3.3.13. Procedures for the proper reuse and disposal of recovered substances, decontamination wastes, contaminated POL and absorbent materials, and procedures to be accomplished prior to resumption of operations.

16.3.3.14. A description of general health, safety, and fire prevention precautions for spill cleanup actions.

16.3.3.15. A public affairs section that describes the procedures, responsibilities, and methods for releasing information in the event of a spill.

16.3.4. Reporting Section. The reporting section of the spill plan will address the following:

16.3.4.1. Recordkeeping when emergency procedures are invoked.

16.3.4.2. Any significant spill will be reported to the FIC immediately. Immediate actions will be taken to eliminate the source and contain the spill.

16.3.4.3. The FIC will immediately notify the appropriate In-Theater Component Commander and/or Defense Agency and the LEC and submit a follow-up written report when:

16.3.4.3.1. The spill occurs inside a DoD installation and cannot be contained within any required berm or secondary containment;

16.3.4.3.2. The spill exceeds 400 liters (110 gallons) of POLs;

16.3.4.3.3. A water resource has been polluted; or

16.3.4.3.4. The FIC has determined that the spill is significant.

16.3.4.4. When a significant spill occurs inside a DoD installation and cannot be contained within the installation boundaries or threatens the local Bahraini drinking water resource, the appropriate in-theater component commander and/or Defense Agency, EEA, and Bahraini Authorities will be notified immediately.

16.3.4.5. If a significant spill occurs outside of a DoD installation, the person in charge at the scene will immediately notify the authorities listed in subparagraph 16.3.4.4, and additionally will notify the local fire departments and obtain necessary assistance.

16.3.5. Installations will provide necessary training and spill response drills to ensure the effectiveness of personnel and equipment.

16.3.6. After completion of the initial response, any remaining free product and/or obviously contaminated soil will be appropriately removed and managed. Further action will be governed by DoDI 4715.8, “Environmental Remediation for DoD Activities Overseas.” Remains from container contents or any leaking materials belonging to one of the categories in Table 6.2 of Chapter 6, “Hazardous Waste”, shall be handled as hazardous waste.

CHAPTER 17

UNDERGROUND STORAGE TANKS

17.1. SCOPE

This Chapter contains criteria to control and abate pollution resulting from POL products and hazardous materials stored in underground storage tanks (USTs). Standards for USTs containing hazardous wastes are covered in Chapter 6, "Hazardous Waste." Criteria for aboveground and below ground POL storage containers are addressed in Chapter 9, "Petroleum, Oil, and Lubricants."

17.2. DEFINITIONS

17.2.1. POL. Refined petroleum, oils, and lubricants.

17.2.2. Hazardous Material. Any material defined as a hazardous material in Chapter 5, "Hazardous Material." The term does not include:

17.2.2.1. Petroleum, including crude POL or any fraction thereof, that is not otherwise specifically listed or designated as a hazardous material above.

17.2.2.2. Natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

17.2.3. Tank Tightness Testing. A test that must be capable of detecting a 0.38 liter (0.1 gallon) per hour leak from any portion of the tank that routinely contains product while accounting for the effects of thermal expansion or contraction of the product, vapor pockets, tank deformation, evaporation or condensation, and the location of the water table.

17.2.4. Underground Storage Tank (UST). Any tank, including underground piping connected thereto, > 416 liters (110 gallons) that is used to contain POL products or hazardous material and the volume of which, including the volume of connected pipes, is 10 % or more beneath the surface of the ground, but does not include:

17.2.4.1. Tanks containing heating oil used for consumption on the premises where it is stored;

17.2.4.2. Septic tanks;

17.2.4.3. Stormwater or wastewater collection systems;

17.2.4.4. Flow through process tanks;

17.2.4.5. Surface impoundments, pits, ponds, or lagoons;

17.2.4.6. Field constructed tanks;

17.2.4.7. Hydrant fueling systems;

17.2.4.8. Storage tanks located in an accessible underground area (such as a basement or vault) if the storage tank is situated upon or above the surface of the floor;

17.2.4.9. UST containing de minimis concentrations of regulated substances, except where subparagraph 17.3.2.7. is applicable; and

17.2.4.10. Emergency spill or overflow containment UST systems that are expeditiously emptied after use.

17.2.5. Hazardous Material UST. A UST that contains a hazardous material (but not including hazardous waste as defined in Chapter 6) or any mixture of such hazardous materials and petroleum, and which is not a petroleum UST.

17.2.6. Deferred UST. A deferred UST is an underground tank system that fits into one of the following categories:

17.2.6.1. A hydrant fuel distribution system; or

17.2.6. 2. A field-constructed tank.

17.3. CRITERIA

17.3.1. All installations will maintain a UST inventory.

17.3.2. POL USTs. All petroleum UST systems will be properly installed, protected from corrosion, provided with spill/overfill prevention, and will incorporate leak detection as described below.

17.3.2.1. Corrosion Protection. USTs and piping must be provided with corrosion protection unless constructed of fiberglass or other non-corrodible materials. The corrosion protection system must be certified by competent authority.

17.3.2.2. Spill/Overflow Protection. USTs will be provided with spill and overfill prevention equipment, except where transfers are made in the amounts of 95 liters (25 gallons) or less. Where spill and over-fill protection are required, a spill containment box must be installed around the fill pipe. Overfill prevention will be provided by one of the following methods:

17.3.2.2.1. Automatic shut-off device (set at 95% of tank capacity).

17.3.2.2.2. High level alarm (set at 90% of tank capacity).

17.3.2.3. Leak Detection. Leak detection systems must be capable of detecting a 0.38-liter (0.1-gallon) per hour leak rate or a release of 568 liters (150 gallons) (or 1% of tank volume, whichever is less) within 30 days with a probability of detection of 0.95 and a probability of false alarm of not more than 0.05.

17.3.2.3.1. USTs will use at least one of the following leak detection methods:

17.3.2.3.1.1. Automatic tank gauging;

17.3.2.3.1.2. Vapor monitoring;

17.3.2.3.1.3. Groundwater monitoring; or

17.3.2.3.1.4. Interstitial monitoring.

17.3.2.3.2. All pressurized UST piping must be equipped with automatic line leak detectors and utilize either an annual tightness test or monthly monitoring.

17.3.2.3.3. Suction piping will either have a line tightness test conducted every three years or use monthly monitoring.

17.3.2.4. USTs and piping will be properly closed if not needed, or be upgraded or replaced.

17.3.2.5. Any UST and piping not incorporating a functioning leak detection system will require immediate corrective action. Such systems will be tightness tested annually in accordance with recognized U.S. industry standards and inventoried monthly to determine system tightness.

17.3.2.6. Any verified leaking UST or UST piping will be immediately removed from service. Any UST and piping suspected of leaking (e.g., leak detection equipment), will be verified for leakage to ensure there is not a false positive, or alternately, will immediately be removed from service. If the UST is still required, it will be repaired or replaced. If the UST is no longer required it will be removed from the ground. When a leaking UST is removed, exposed free product and/or obviously contaminated soil in the immediate vicinity of the tank will be appropriately removed and managed. Additional action will be governed by DoDI 4715.8 (Environmental Remediation for DoD Activities Overseas). Under extenuating circumstances (e.g., where the UST is located under a building), the UST will be cleaned and filled with an inert substance, and left in place.

17.3.2.7. When a UST has not been used for one year, or is determined to no longer be required, all of the product and sludges must be removed. Subsequently, the UST must be either cleaned and filled with an inert substance, or removed. UST wastes must be sampled and tested in accordance with Chapter 9, “Petroleum, Oil, and Lubricants,” paragraph 9.3.3.

17.3.2.8. When the product stored in a UST is changed, the UST must be emptied and cleaned by removing all liquid and accumulated sludge.

17.3.2.9. When a UST system is temporarily closed, corrosion protection and leak detection systems (if the UST is not empty) must be operated and maintained. If a UST system is temporarily closed for 3 months or greater, the following must be complied with:

17.3.2.9.1. Vent lines must be left open and functioning; and

17.3.2.9.2. All other lines, pumps, manways, and ancillary equipment must be secured and capped.

17.3.3. UST Recordkeeping. Installations will maintain a tank system inventory to include tank system installation, repair, removal, replacement, or upgrade, and operation of corrosion protection equipment for the life of the tank.

17.3.4. Hazardous Material USTs

17.3.4.1. All hazardous material USTs and piping must meet the same design and construction standards as required for petroleum USTs and piping, and in addition must be provided with secondary containment for both tank and piping. Secondary containment can be met by using double-walled tanks and piping, liners, or vaults.

17.3.4.2. Leak Detection. The interstitial space (space between the primary and secondary containment) for tanks and piping must be monitored monthly for liquids or vapors.

17.3.4.3. Hazardous material USTs and piping that do not incorporate the criteria contained in subparagraph C17.3.4.1. shall be immediately removed from service and upgraded or replaced as necessary.

17.3.5. Deferred USTs. Deferred USTs constructed after 8 May 1985 must be designed and constructed with corrosion protection, non-corrodible materials, or be otherwise designed and constructed to prevent releases from corrosion or structural failure. UST materials must be compatible with the substance(s) to be stored.

A1. APPENDIX 1
CHARACTERISTICS OF HAZARDOUS WASTES AND LISTS OF HAZARDOUS WASTES AND HAZARDOUS MATERIALS

A1.1. CHARACTERISTICS OF HAZARDOUS WASTE

A1.1.1. General

A1.1.1.1. A solid waste is a discarded material that may be solid, semi-solid, liquid, or that contained gas.

A1.1.1.2. A solid waste becomes a hazardous waste when it exhibits a characteristic of a hazardous waste or is listed as a hazardous waste in this Appendix. A hazardous waste or any mixture of a solid waste and a hazardous waste that is listed solely because it exhibits one or more characteristics of ignitability, corrosivity, or reactivity, is not a hazardous waste if the waste no longer exhibits any characteristic of hazardous waste.

A1.1.1.3. Each hazardous waste is identified by a USEPA Hazardous Waste Number (HW#). The HW# must be used in complying with the notification, recordkeeping, and reporting requirements.

A1.1.2. Characteristic of Ignitability

A1.1.2.1. A solid waste exhibits the characteristic of ignitability if a representative sample of the waste has any of the following properties:

A1.1.2.1.1. It is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume and has a flash point less than 60°C (140°F), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in American Society for Testing and Materials (ASTM) Standard D-93-79 or D-93-80 or a Setaflash Closed Cup Tester, using the test method specified in ASTM Standard D-3278-78, or as determined by an equivalent test method.

A1.1.2.1.2. It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

A1.1.2.1.3. It is an ignitable compressed gas as determined by appropriate test methods or USEPA.

A1.1.2.1.4. It is an oxidizer.

A1.1.2.2. A solid waste that exhibits the characteristic of ignitability has the USEPA HW# D001.

A1.1.3. Characteristic of Corrosivity

A1.1.3.1. A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:

A1.1.3.1.1. It is aqueous and has a pH less than or equal to 2, or greater than or equal to 12.5, as determined by a pH meter.

A1.1.3.1.2. It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55°C (130°F) as determined by the test method specified in National Association of Corrosion Engineers (NACE) Standard TM-01-69 as standardized in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods."

A1.1.3.2. A solid waste that exhibits the characteristic of corrosivity has the USEPA HW# D002.

A1.1.4. Characteristic of Reactivity

A1.1.4.1. A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has any of the following properties:

A1.1.4.1.1. It is normally unstable and readily undergoes violent change without detonating.

A1.1.4.1.2. It reacts violently with water.

A1.1.4.1.3. It forms potentially explosive mixtures with water.

A1.1.4.1.4. When mixed with water, it generates toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.

A1.1.4.1.5. It is a cyanide or sulfide-bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.

A1.1.4.1.6. It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

A1.1.4.1.7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

A1.1.4.1.8. It is a forbidden explosive.

A1.1.4.2. A solid waste that exhibits the characteristic of reactivity has the USEPA HW# D003.

A1.1.5. Toxicity Characteristic

A1.1.5.1. A solid waste exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, the extract from a representative sample of the waste contains any of the contaminants listed in Table AP1.T1., "Maximum Concentration of Contaminants for the Toxicity Characteristic," or section A1.1. at the concentration equal to or greater than the respective value given in that table. Where the waste contains less than 0.5 percent filterable solids, the waste itself is considered to be the extract for the purpose of this section.

A1.1.5.2. A solid waste that exhibits the characteristic of toxicity has the USEPA HW# specified in Table AP1.T1 or section A1.2., which corresponds to the toxic contaminant causing it to be hazardous.

A1.2. LISTS OF HAZARDOUS WASTES

A1.2.1. General

A1.2.1.1. A solid waste is a hazardous waste if it is listed in this section.

A1.2.1.2. The basis for listing the classes or types of wastes listed employed one or more of the following Hazard Codes:

Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Toxicity Characteristic Waste	(E)
Acute Hazardous Waste	(H)
Toxic Waste	(T)

A1.2.1.3. Each hazardous waste listed in section A1.2 of this Appendix is assigned a USEPA HW# which precedes the name of the waste. This number must be used in complying with the notification, recordkeeping and reporting requirements of these alternate standards.

A1.2.2. Hazardous Wastes from Non-Specific Sources. The solid wastes in Table AP1.T3., "Listed Hazardous Wastes from Non-Specific Sources," are listed hazardous wastes from non-specific sources. These hazardous wastes are designated with an "F."

A1.2.3. Hazardous Wastes from Specific Sources. The solid wastes listed in Table AP1.T4., annotated "K" as the first character of the USEPA Hazardous Waste No. column, are listed hazardous wastes from specific sources.

A1.2.4. Discarded Commercial Chemical Products, Off-Specification Species, Container Residues, and Spill Residue.

A1.2.4.1. The following materials or items are hazardous wastes if and when they are discarded or intended to be discarded when they are mixed with waste oil or used oil or other material and applied to the land for dust suppression or road treatment, when they are otherwise applied to the land in lieu of their original intended use or when they are contained in products that are applied to the land in lieu of their original intended use, or when, in lieu of their original

intended use, are produced for use as (or as a component of) a fuel, distributed for use as a fuel or burned as a fuel.

A1.2.4.1.1. Any commercial chemical product, or manufacturing chemical intermediate having the generic name listed in Table AP1.T4., annotated "P" or "U" as the first character in the USEPA HW#.

A1.2.4.1.2. Any off-specification commercial chemical product or manufacturing chemical intermediate ***which, if it met specifications, would have the generic name listed in*** Table AP1.T4., annotated "P" or "U" as the first character in the USEPA HW#.

A1.2.4.1.3. Any residue remaining in a container or in an inner liner removed from a container that has held any commercial chemical product or manufacturing chemical intermediate having the generic name listed in Table AP1.T4., annotated "P" or "U" as the first character in the USEPA HW#, unless the container is empty. [Comment: Unless the residue is being beneficially used or reused, or legitimately recycled or reclaimed; or being accumulated, stored, transported or treated prior to such use, re-use, recycling or reclamation, the residue to be intended for discard, and thus, a hazardous waste. An example of a legitimate re-use of the residue would be where the residue remains in the container and the container is used to hold the same commercial chemical product or manufacturing chemical intermediate it previously held. An example of the discard of the residue would be where the drum is sent to a drum reconditioner who reconditions the drum but discards the residue.]

A1.2.4.1.4. Any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having the generic name listed in Table AP1.T4., annotated "P" or "U" as the first character in the USEPA HW#, or any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water, of any off-specification chemical product and manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in Table AP1.T4., annotated "P" or "U" as the first character in the USEPA HW#. [Comment: The phrase "commercial chemical product or manufacturing chemical intermediate having the generic name listed in..." refers to a chemical substance that is manufactured or formulated for commercial or manufacturing use which consists of the commercially pure grade of the chemical, any technical grades of the chemical that are produced or marketed, and all formulations in which the chemical is the sole active ingredient. It does not refer to a material, such as a manufacturing process waste, that contains any of the substances listed in Table AP1.T4., annotated "P" or "U" as the first character in the USEPA HW#. Where a manufacturing process waste is deemed to be a hazardous waste because it contains a substance listed in Table AP1.T4., annotated "P" or "U" as the first character in the USEPA HW#, such waste will be listed in paragraph AP1.2.2. above or will be identified as a hazardous waste by the characteristics set forth in section AP1.1. of this Appendix.]

A1.2.4.1.5. The commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products or manufacturing chemical intermediates referred to in Table AP1.T4., annotated "P" as the first character in the USEPA HW# are hereby identified as acute hazardous waste (H). [Comment: For the convenience of the regulated community, the primary hazardous properties of these materials have been indicated by

the letters T (Toxicity), and R (Reactivity). Absence of a letter indicates that the compound is only listed for acute toxicity.] These wastes and their corresponding USEPA HW#s are listed in Table AP1.T4., annotated "P" as the first character in the USEPA HW#.

A1.2.4.1.6. The commercial chemical products, manufacturing chemical intermediates, or off-specification commercial chemical products referred to in Table AP1.T4., subparagraphs A1.2.4.1.1.1. through A1.2.4.1.1.4. of this section, are hereby identified as toxic wastes (T), unless otherwise designated. [Comment: For the convenience of the regulated community, the primary hazardous properties of these materials have been indicated by the letter T (Toxicity), R (Reactivity), I (Ignitability), and C (Corrosivity). Absence of a letter indicates that the compound is only listed for toxicity.]

Table AP1.T1. Maximum Concentration of Contaminants for the Toxicity Characteristic

USEPA HW No.[1]	Contaminant	CAS No. [2]	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D006	Cadmium	7440-43-2	1.0
D007	Chromium	7440-47-3	5.0
D016	2,4-D	94-75-7	10.0
D012	Endrin	72-20-8	0.02
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D015	Toxaphene	8001-35-2	0.5
D017	2,4,5-TP (Silvex)	93-72-1	1.0

Notes

1. U.S. EPA Hazardous Waste number.
2. Chemical Abstracts Service number.

Table AP1.T2. Maximum Concentration of Contaminants for Non-Wastewater

USEPA HW No. [1]	Contaminant	CAS No. [2]	Regulatory Level (mg/kg)
D018	Benzene	71-43-2	0.5
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D023	o-Cresol	95-48-7	200.0
D024	m-Cresol	108-39-4	200.0
D025	p-Cresol	106-44-5	200.0
D026	Cresol		200.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13
DO33	Hexachlorobutadiene	87-68-3	0.5
DO34	Hexachloroethane	67-72-1	3.0
DO35	Methyl Ethyl Ketone	78-93-3	200.0
DO36	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D043	Vinyl Chloride	75-01-4	0.2

Notes

1. U.S. EPA Hazardous Waste number.
2. Chemical Abstracts Service number.

Table AP1.T3. Listed Hazardous Wastes from Non-Specific Sources

USEPA HW No.[1]	Hazardous Waste	Hazard Code
F001	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(T)
F002	The following spend halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(T)
F003	The following spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(I)[2]
F004	The following spent non-halogenated solvents: Cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(T)
F005	The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(I,T)
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.	(T)
F007	Spent cyanide plating bath solutions from electroplating operations.	(R,T)

Table AP1.T3. Listed Hazardous Wastes from Non-Specific Sources

USEPA HW No.[1]	Hazardous Waste	Hazard Code
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.	(R,T)
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.	(R,T)
F010	Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process.	(R,T)
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations.	(R,T)
F012	Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process.	(T)
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum except from zirconium phosphating in aluminum can washing when such phosphating is an exclusion conversion coating process.	(T)
F020	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives (This listing does not include wastes from the production of Hexachlorophene from highly purified 2,4,5- trichlorophenol).	(H)
F021	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives.	(H)
F022	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions.	(H)
F023	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols (This listing does not include wastes from equipment used only for the production or use of Hexachlorophene from highly purified 2,4,5- trichlorophenol).	(H)
F024	Process wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes, from the production of certain chlorinated aliphatic hydrocarbons by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution (This listing does not include wastewaters, wastewater treatment sludges, spent catalysts, and wastes listed in Sec26131 or Sec26132).	(T)

Table AP1.T3. Listed Hazardous Wastes from Non-Specific Sources

USEPA HW No.[1]	Hazardous Waste	Hazard Code
F025	Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution.	(T)
F026	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions.	(H)
F027	Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols (This listing does not include formulations containing Hexachlorophene synthesized from prepurified 2,4,5- trichlorophenol as the sole component).	(H)
F028	Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Numbers F020, F021, F022, F023, F026, and F027.	(T)
F032	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations (except potentially cross- contaminated wastes that have had the F032 waste code deleted in accordance with Sec 26135 of this chapter or potentially cross-contaminated wastes that are otherwise currently regulated as hazardous wastes (i.e., F034 or F035), and where the generator does not resume or initiate use of chlorophenolic formulations). This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.	(T)
F034	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.	(T)
F035	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.	(T)

Table AP1.T3. Listed Hazardous Wastes from Non-Specific Sources

USEPA HW No.[1]	Hazardous Waste	Hazard Code
F037	Petroleum refinery primary oil/water/solids separation sludge—Any sludge generated from the gravitational separation of oil/water/ solids during the storage or treatment of process wastewaters and oily cooling wastewaters from petroleum refineries. Such sludges include, but are not limited to, those generated in: oil/water/ solids separators; tanks and impoundments; ditches and other conveyances; sumps; and stormwater units receiving dry weather flow. Sludge generated in stormwater units that do not receive dry weather flow, sludges generated from non- contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges generated in aggressive biological treatment units as defined in Sec 26131(b)(2) (including sludges generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and K051 wastes are not included in this listing.	(T)
F038	Petroleum refinery secondary (emulsified) oil/water/solids separation sludge—Any sludge and/or float generated from the physical and/or chemical separation of oil/water/ solids in process wastewaters and oily cooling wastewaters from petroleum refineries. Such wastes include, but are not limited to, all sludges and floats generated in: induced air flotation (IAF) units, tanks and impoundments, and all sludges generated in DAF units. Sludges generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges and floats generated in aggressive biological treatment units as defined in Sec 26131(b)(2) (including sludges and floats generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and F037, K048, and K051 wastes are not included in this listing.	(T)
F039	Leachate (liquids that have percolated through land disposed wastes) resulting from the disposal of more than one restricted waste classified as hazardous under subpart D of this part (Leachate resulting from the disposal of one or more of the following EPA Hazardous Wastes and no other Hazardous Wastes retains its EPA Hazardous Waste Number(s): F020, F021, F022, F026, F027, and/or F028)	(T)

Notes

1. U.S. EPA Hazardous Waste number.
2. (I,T) should be used to specify mixtures containing ignitable and toxic constituents.

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Acenaphthene	83329			100
Acenaphthylene	208968			5,000
Acetaldehyde (I)	75070		U001	1,000
Acetaldehyde, chloro-	107200		P023	1,000
Acetaldehyde, trichloro-	75876		U034	5,000
Acetamide	60355			100
Acetamide, N-(aminothioxomethyl)-	591082		P002	1,000
Acetamide, N-(4-ethoxyphenyl)-	62442		U187	100
Acetamide, 2-fluoro-	640197		P057	100
Acetamide, N-9H-fluoren-2-yl-	53963		U005	1
Acetic acid	64197			5,000
Acetic acid (2,4-dichlorophenoxy)-salts and esters	94757		U240	100
Acetic acid, lead(2+) salt	301042		U144	10
Acetic acid, thallium(1+) salt	563688		U214	1000
Acetic acid, (2,4,5-trichlorophenoxy)	93765		U232	1,000
Acetic acid, ethyl ester (I)	141786		U112	5,000
Acetic acid, fluoro-, sodium salt	62748		P058	10
Acetic anhydride	108247			5,000
Acetone (I)	67641		U002	5,000
Acetone cyanohydrin	75865	1,000	P069	10
Acetone thiosemicarbazide	1752303	1,000/10,000		1
Acetonitrile (I,T)	75058		U003	5,000
Acetophenone	98862		U004	5,000
2-Acetylaminofluorene	53963		U005	1
Acetyl bromide	506967			5,000
Acetyl chloride (C,R,T)	75365		U006	5,000
1-Acetyl-2-thiourea	591082		P002	1
Acrolein	107028	500	P003	1
Acrylamide	79061	1,000/10,000	U007	5,000
Acrylic acid (I)	79107		U008	5,000
Acrylonitrile	107131	10,000	U009	100
Acrylyl chloride	814686	100		1
Adipic acid	124049			5,000
Adiponitrile	111693	1,000		1
Aldicarb	116063	100/10,000	P070	1
Aldrin	309002	500/10,000	P004	1
Allyl alcohol	107186	1,000	P005	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Allylamine	107119	500		1
Allyl chloride	107051			1,000
Aluminum phosphide (R,T)	20859738	500	P006	100
Aluminum sulfate	10043013			5,000
4-Aminobiphenyl	92671			1
5-(Aminomethyl)-3-isoxazolol	2763964		P007	1,000
Aminopterin	54626	500/10,000		1
4-Aminopyridine	504245		P008	1,000
Amiton	78535	500		1
Amiton oxalate	3734972	100/10,000		1
Amitrole	61825		U011	10
Ammonia	7664417	500		100
Ammonium acetate	631618			5,000
Ammonium benzoate	1863634			5,000
Ammonium bicarbonate	1066337			5,000
Ammonium bichromate	7789095			10
Ammonium bifluoride	1341497			100
Ammonium bisulfite	10192300			5,000
Ammonium carbamate	1111780			5,000
Ammonium carbonate	506876			5,000
Ammonium chloride	12125029			5,000
Ammonium chromate	7788989			10
Ammonium citrate, dibasic	3012655			5,000
Ammonium fluoborate	13826830			5,000
Ammonium fluoride	12125018			100
Ammonium hydroxide	1336216			1,000
Ammonium oxalate	6009707			5,000
	5972736			
	14258492			
Ammonium picrate (R)	131748		P009	10
Ammonium silicofluoride	16919190			1,000
Ammonium sulfamate	7773060			5,000
Ammonium sulfide	12135761			100
Ammonium sulfite	10196040			5,000
Ammonium tartrate	14307438			5,000
	3164292			
Ammonium thiocyanate	1762954			5,000
Ammonium vanadate	7803556		P119	1,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Amphetamlne	300629	1,000		1
Amyl acetate	628637			5,000
Iso-Amyl acetate	123922			
Sec-Amyl acetate	626380			
Tert-Amyl acetate	625161			
Aniline (I,T)	62533	1,000	U012	5,000
Aniline, 2,4,6- trimethyl	88051	500		1
o-Anisidine	90040			100
Anthracene	120127			5,000
Antimony++	7440360			5,000
Antimony pentachloride	7647189			1,000
Antimony pentafluoride	7783702	500		1
Antimony potassium tartrate	28300745			100
Antimony tribromide	7789619			1,000
Antimony trichloride	10025919			1,000
Antimony trifluoride	7783564			1,000
Antimony trioxide	1309644			1,000
Antimycin A	1397940	1,000/10,000		1
ANTU (Thiourea 1-Naphthalenyl)	86884	500/10,000		100
Argentate(1-), bis(cyano-C)-, potassium	506616		P099	1
Aroclor 1016	12674112			1
Aroclor 1221	11104282			1
Aroclor 1232	11141165			1
Aroclor 1242	53469219			1
Aroclor 1248	12672296			1
Aroclor 1254	11097691			1
Aroclor 1260	11096825			1
Aroclors	1336363			1
Arsenic++	7440382			1
Arsenic acid H_3AsO_4	1327522		P010	1
	7778394			
Arsenic disulfide	1303328			1
Arsenic oxide As_2O_3	1327533		P012	1
Arsenic oxide As_2O_5	1303282		P011	1
Arsenic pentoxide	1303282	100/10,000	P011	1
Arsenic trichloride	7784341			1
Arsenic trioxide	1327533		P012	1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Arsenic trisulfide	1303339			1
Arsenous oxide	1327533	100/10,000	P012	1
Arsenous trichloride	7784341	500		5,000
Arsine	7784421	100		1
Arsine, diethyl-	692422		P038	1
Arsinic acid, dimethyl-	75605		U136	1
Arsorous dichloride, phenyl-	696286		P036	1
Asbestos+++	1332214			1
Auramine	492808		U014	100
Azaserine	115026		U015	1
Aziridine	151564		P054	1
Azindine, 2-methyl-	75558		P067	1
Azirino[2',3',3,4]pyrrolo[1,2-a]indole-4, 7-dione,6-amino-8-[[aminocarbonylooxy) methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-,[1aS-(1a-alpha, 8-beta, 8a-alpha, 8b-alpha)]-	50077		U010	10
Azinphos-ethyl	2642719	100/10,000		100
Azinphos-methyl	86500	10/10,000		1
Barium cyanide	542621		P013	10
Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-	56495		U157	10
Benz[c]acridine	225514		U016	100
Benzal chloride	98873	500	U017	5,000
Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-	23950585		U192	5,000
Benz[a]anthracene	56553		U018	10
1,2-Benzanthracene	56553		U018	10
Benz[a]anthracene, 7,12-dimethyl-	57976		U094	1
Benzenamine (I,T)	62533		U012	5,000
Benzenamine, 3-(Trifluoromethyl)	98168	500		1
Benzenamine, 4,4'-carbonimidoylbis (N,N-dimethyl-	492808		U014	100
Benzenamine, 4-chloro-	106478		P024	1,000
Benzenamine, 4-chloro-2-methyl-, hydrochloride	3165933		U049	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Benzenamine, N,N-dimethyl-4-(phenylazo-)	60117		U093	10
Benzenamine, 2-methyl-	95534		U328	100
Benzenamine, 4-methyl-	106490		U353	100
Benzenamine, 4,4'-methylenebis(2-chloro-	101144		U158	10
Benzenamine, 2-methyl-, hydrochloride	636215		U222	100
Benzenamine, 2-methyl-5-nitro-	99558		U181	100
Benzenamine, 4-nitro-	100016		P077	5,000
Benzene (I,T)	71432		U109	10
Benzene, 1-(Chloromethyl)-4-Nitro-	100141	500/10,000		1
Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester	510156		U038	10
Benzene, 1-bromo-4-phenoxy-	101553		U030	100
Benzenearsonic Acid	98055	10/10,000		1
Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-	305033		U035	10
Benzene, chloro-	108907		U037	100
Benzene, chloromethyl-	100447		P028	100
Benzenediamin, ar-methyl-	25376458		U221	10
	95807			
	496720			
	823405			
1,2-Benzenedicarboxylic acid, dioctyl ester	117840		U107	5,000
1,2-Benzenedicarboxylic acid, [bis(2-ethylhexyl)]-ester	117817		U028	100
1,2-Benzenedicarboxylic acid, dibutyl ester	84742		U069	10
1,2-Benzenedicarboxylic acid, diethyl ester	84662		U088	1,000
1,2-Benzenedicarboxylic acid, dimethyl ester	131113		U102	5,000
Benzene, 1,2-dichloro-	95501		U070	100
Benzene, 1,3-dichloro-	541731		U071	100
Benzene, 1,4-dichloro-	106467		U072	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro-	72548		U060	1
Benzene, dichloromethyl-	98873		U017	5,000
Benzene, 1,3-diisocyanotomethyl- (R,T)	584849		U223	100
	91087			
	264716254			
Benzene, dimethyl (I,T)	1330207		U239	100
m-Benzene, dimethyl	108383			1,000
o-Benzene, dimethyl	95476			1,000
p-Benzene, dimethyl	106423			100
1,3-Benzenediol	108463		U201	5,000
1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]- (R) -	51434		P042	1,000
Benzeneethanamine, alpha, alpha-dimethyl-	122098		P046	5,000
Benzene, hexachloro-	118741		U127	10
Benzene, hexahydro- (I)	110827		U056	1,000
Benzene, hydroxy-	108952		U188	1,000
Benzene, methyl-	108883		U220	1,000
Benzene, 2-methyl-1,3-dinitro-	606202		U106	100
Benzene, 1-methyl-2,4-dinitro-	121142		U105	10
Benzene, 1-methylethyl- (I)	98828		U055	5,000
Benzene, nitro-	98953		U169	1,000
Benzene, pentachloro-	608935		U183	10
Benzene, pentachloronitro-	82688		U185	100
Benzenesulfonic acid chloride (C,R)	98099		U020	100
Benzenesulfonyl chloride	98099		U020	100
Benzene, 1,2,4,5-tetrachloro-	95943		U207	5,000
Benzenethiol	108985		P014	100
Benzene, 1,1'-(2,2,2-tri-chloroethylidene)bis[4-chloro-	50293		U061	1
Benzene, 1,1'-(2,2,2-trichloroethylidene) bis[4-methoxy-	72435		U247	1
Benzene, (trichloromethyl)-	98077		U023	10
Benzene, 1,3,5-trinitro-	99354		U234	10
Benzidine	92875		U021	1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Benzimidazole, 4,5-Dichloro-2-(Trifluoromethyl)-	3615212	500/10,000		1
1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide	81072		U202	100
Benzo[a]anthracene	56553		U018	10
Benzo[b]fluoranthene	205992			1
Benzo[k]fluoranthene	207089			5,000
Benzo[j,k]fluorene	206440		U120	100
1,3-Benzodioxole, 5-(1-propenyl)-	120581		U141	100
1,3-Benzodioxole, 5-(2-propenyl)-	94597		U203	100
1,3-Benzodioxole, 5-propyl-	94586		U090	10
Benzoic acid	65850			5,000
Benzonitrile	100470			5,000
Benzo[rst]pentaphene	189559		U064	10
Benzo[ghi]perylene	191242			5,000
2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts, when present at concentrations greater than 0.3%	81812		P001	100
Benzo[a]pyrene	50328		U022	1
3,4-Benzopyrene	50328		U022	1
p-Benzoquinone	106514		U197	10
Benzotrichloride (C,R,T)	98077	500	U023	10
Benzoyl chloride	98884			1,000
1,2-Benzphenanthrene	218019		U050	100
Benzyl chloride	100447	500	P028	100
Benzyl cyanide	140294	500		1
Beryllium++	7440417		P015	10
Beryllium chloride	7787475			1
Beryllium fluoride	7787497			1
Beryllium nitrate	13597994			1
	7787555			
alpha-BHC	319846			10
beta-BHC	319857			1
delta-BHC	319868			1
gamma-BHC	58899		U129	1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Bicyclo [2,2,1]Heptane-2-carbonitrile, 5-chloro-6-(((Methylamino)Carbonyl) Oxy)Imino)-,(1s-(1-alpha, 2-beta, 4-alpha, 5-alpha, 6E))-	15271417	500/10,000		1
2,2'-Bioxirane	1464535		U085	10
Biphenyl	92524			100
(1,1'-Biphenyl)-4,4'diamine	92875		U021	1
(1,1'-Biphenyl)-4,4'diamine, 3,3'dichloro-	91941		U073	1
(1,1'-Biphenyl)-4,4'diamine, 3,3'dimethoxy-	119904		U091	10
(1,1'-Biphenyl)-4,4'diamine, 3,3'dimethyl-	119937		U095	10
Bis(chloromethyl) ketone	534076	10/10,000		1
Bis(2-chloroethyl)ether	111444		U025	10
Bis(2-chloroethoxy)methane	111911		U024	1,000
Bis(2-ethylhexyl)phthalate	117817		U028	100
Bitoscanate	4044659	500/10,000		1
Boron trichloride	10294345	500		1
Boron trifluoride	7637072	500		1
Boron trifluoride compound with methyl ether (1:1)	353424	1,000		1
Bromoacetone	598312		P017	1,000
Bromadiolone	28772567	100/10,000		1
Bromine	7726956	500		1
Bromoform	75252		U225	100
4-Bromophenyl phenyl ether	101553		U030	100
Brucine	357573		P018	100
1,3-Butadiene	106990			10
1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	87683		U128	1
1-Butanamine, N-butyl-N-nitroso-	924163		U172	10
1-Butanol	71363		U031	5,000
2-Butanone	78933		U159	5,000
2-Butanone peroxide (R,T)	1338234		U160	10
2-Butanone, 3,3-dimethyl-1-(methylthio)-, O[(methylamno)carbonyl] oxime	39196184		P045	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
2-Butenal	123739		U053	100
	4170303			
2-Butene, 1,4-dichloro- (I,T)	764410		U074	1
2-Butenoic acid, 2-methyl-, 7[[2,3-dihydroxy-2-(1-meth- oxyethyl)-3-methyl-1-oxobutoxy] methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1-alpha(Z),7(2S*,3R*), 7a-alpha]]-	303344		U143	10
Butyl acetate	123864			5,000
iso-Butyl acetate	110190			
sec-Butyl acetate	105464			
tert-Butyl acetate	540885			
n-Butyl alcohol (I)	71363		U031	5,000
Butylamine	109739			1,000
iso-Butylamine	78819			
sec-Butylamine	513495			
tert-Butylamine	13952846			
	75649			
Butyl benzyl phthalate	85687			100
n-Butyl phthalate	84742		U069	10
Butyric acid	107926			5,000
iso-Butyric acid	79312			
Cacodylic acid	75605		U136	1
Cadmium++ (2+)	7440439			10
Cadmium acetate	543908			10
Cadmium bromide	7789426			10
Cadmium chloride	10108642			10
Cadmium oxide	1306190	100/10,000		1
Cadmium stearate	2223930	1,000/10,000		1
Calcium arsenate	7778441	500/10,000		1
Calcium arsenite	52740166			1
Calcium carbide	75207			10
Calcium chromate	13765190		U032	10
Calcium cyanamide	156627			1,000
Calcium cyanide Ca(CN)2	592018		P021	10
Calcium dodecylbenzenesulfonate	26264062			1,000
Calcium hypochlorite	7778543			10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Camphechlor	8001352	500/10,000		1
Camphene, octachloro-	8001352		P123	1
Cantharidin	56257	100/10,000		1
Carbachol chloride	51832	500/10,000		1
Caprolactum	105602			5,000
Captan	133062			10
Carbamic acid, ethyl ester	51796		U238	100
Carbamic acid, methylnitroso-, ethyl ester	615532		U178	1
Carbamic acid, Methyl-, 0-(((2,4-Dimethyl-1, 3-Dithiolan-2-yl)Methyllene)Amino)-	26419738	100/10,000		1
Carbamic chloride, dimethyl-	79447		U097	1
Carbamodithioic acid, 1,2-ethaneiylbis, salts & esters	111546		U114	5,000
Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester	2303164		U062	100
Carbaryl	63252			100
Carbofuran	1563662	10/10,000		10
Carbon disulfide	75150	10,000	P022	100
Carbon oxyfluoride (R,T)	353504		U033	1,000
Carbon tetrachloride	56235		U211	10
Carbonic acid, dithallium(1+) salt	6533739		U215	100
Carbonic dichloride	75445		P095	10
Carbonic difluoride	353504		U033	1,000
Carbonochloridic acid, methyl ester	79221		U156	1,000
Carbonyl Sulfide	463581			100
Carbophenothion	786196	500		1
Catechol	120809			100
Chloral	75876		U034	5,000
Chlorambem	133904			100
Chlorambucil	305033		U035	10
Chlordane	57749	1,000	U036	1
Chlordane, alpha & gamma isomers	57749		U036	1
Chlordane, technical	57749		U036	1
Chlorfenvinfos	470906	500		1
Chlorinated champhene (Campheclor)	8001352			1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Chlorine	7782505	100		10
Chlormephos	24934916	500		1
Chlormequat chloride	999815	100/10,000		1
Chlornaphazine	494031		U026	100
Choroacetaldehyde	107200		P023	1,000
Chloroacetophenone	532274			100
Chloroacetic acid	79118	100/10,000		100
p-Chloroaniline	106478		P024	1,000
Chlorobenzene	108907		U037	100
Chlorobenzilate	510156		U038	10
p-Chloro-m-cresol (4)	59507		U039	5,000
1-Chloro-2,3-epoxypropane	106898		U041	100
Chlorodibromomethane	124481			100
Chloroethane	75003			100
Chloroethanol	107073	500		1
Chloroethyl chlorofomate	627112	1,000		1
2-Chloroethyl vinyl ether	110758		U042	1,000
Chloroform	67663	10,000	U044	10
Chloromethane	74873		U045	100
Chloromethyl ether	542881	100	P016	1
Chloromethyl methyl ether	107302	100	U046	1
beta-Chloronaphthalene	91587		U047	5,000
2-Chloronaphthalene	91587		U047	5,000
Chlorophacinone	3691358	100/10,000		1
o-Chlorophenol (2)	95578		U048	100
4-Chlorophenyl phenyl ether	7005723			5,000
1-(o-Chlorophenyl)thiourea	5344821		P026	100
Chloroprene	126998			100
3-Chloropropionitrile	542767		P027	1,000
Chlorosulfonic acid	7790945			1,000
4-Chloro-o-toluidine, hydrochloride	3165933		U049	100
Chlorpyrifos	2921882			1
Chloroxuron	1982474	500/10,000		1
Chlorthiophos	21923239	500		1
Chromic acetate	1066304			1,000
Chromic acid	11115745			10
	7738945			
Chromic acid H_2CrO_4, calcium salt	13765190		U032	10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Chromic chloride (Chromium chloride)	10025737	1/10,000		1
Chromic sulfate	10101538			1,000
Chromium++	7440473			5,000
Chromous chloride	10049055			1,000
Chrysene	218019		U050	100
Cobalt, ((2,2'-(1,2-ethanediylbis (Nitrilo-methylidyne))Bis(6-fluoro-phenolato))(2-)-N,N',O,O')-,	62207765	100/10,000		1
Cobaltous bromide	7789437			1,000
Cobalt carbonyl	10210681	10/10,000		1
Cobaltous formate	544183			1,000
Cobaltous sulfamate	14017415			1,000
Coke Oven Emissions	NA			1
Colchicine	64868	10/10,000		1
Copper++	7440508			5,000
Copper cyanide	544923		P029	10
Coumaphos	56724	100/10,000		10
Coumatetralyl	5836293	500/10,000		1
Creosote	8001589		U051	1
Cresol(s) (Phenol, Methyl)	1319773		U052	100
m-Cresol	108394	1,000/10,000		100
o-Cresol	95487			100
p-Cresol	106445			100
Cresylic acid	1319773		U052	100
m-Cresylic acid	108394			100
o-Cresylic acid	95487			100
p-Cresylic acid	106445			100
Crimidine	535897	100/10,000		1
Crotonaldehyde	123739	1,000	U053	100
	4170303	1,000		100
Cumene (I)	98828		U055	5,000
Cupric acetate	142712			100
Cupric acetoarsenite	12002038			1
Cupric chloride	7447394			10
Cupric nitrate	3251238			100
Cupric oxalate	5893663			100
Cupric sulfate	7758987			10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Cupric sulfate, ammoniated	10380297			100
Cupric tartrate	815827			100
Cyanides (soluble salts and complexes) not otherwise specified	57125		P030	10
Cyanogen	460195		P031	100
Cyanogen bromide	506683	500/10,000	U246	1,000
Cyanogen chloride	506774		P033	10
Cyanogen iodide (Iodine cyanide)	506785	1,000/10,000		1
Cyanophos	2636262	1,000		1
Cyanuric fluoride	675149	100		1
2,5-Cyclohexadiene-1,4-dione	106514		U197	10
Cyclohexane (I)	110827		U056	1,000
Cyclohexane, 1,2,3,4,5,6-hexachloro, (1-alpha, 2-alpha, 3-beta, 4-alpha, 5-alpha, 6-beta)-	58899		U129	1
Cyclohexanone (I)	108941		U057	5,000
2-Cyclohexanone	131895		P034	100
Cycloheximide	66819	100/10,000		1
Cyclohexylamine	108918	10,000		1
1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	77474		U130	10
Cyclophosphamide	50180		U058	10
2,4-D Acid	94757		U240	100
2,4-D Ester	94111			100
	94791			
	94804			
	1320189			
	1928387			
	1928616			
	1929733			
	2971382			
	25168267			
	53467111			
2,4-D, salts & esters (2,4-Dichlorophenoxyacetic Acid)	94757		U240	100
Daunomycin	20830813		U059	10
Decarborane(14)	17702419	500/10,000		1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Demeton	8065483	500		1
Demeton-S-Methyl	919868	500		1
DDD, 4,4'DDD	72548		U060	1
DDE, 4,4'DDE	72559			1
DDT, 4,4'DDT	50293		U061	1
DEHP (Diethylhexyl phthalate)	117817		U028	100
Diallate	2303164		U062	100
Dialifor	10311849	100/10,000		1
Diazinon	333415			1
Diazomethane	334883			100
Dibenz[a,h]anthracene	53703		U063	1
1,2:5,6-Dibenzanthracene	53703		U063	1
Dibenzo[a,h]anthracene	53703		U063	1
Dibenzofuran	132649			100
Dibenz[a,i]pyrene	189559		U064	10
1,2-Dibromo-3-chloropropane	96128		U066	1
Dibromoethane	106934		U067	1
Diborane	19287457	100		1
Dibutyl phthalate	84742		U069	10
Di-n-butyl phthalate	84742		U069	10
Dicamba	1918009			1,000
Dichlobenil	1194656			100
Dichlone	117806			1
Dichlorobenzene	25321226			100
m-Dichlorobenzene (1,3)	541731		U071	100
o-Dichlorobenzene (1,2)	95501		U070	100
p-Dichlorobenzene (1,4)	106467		U072	100
3,3'-Dichlorobenzidine	91941		U073	1
Dichlorobromomethane	75274			5,000
1,4-Dichloro-2-butene (I,T)	764410		U074	1
Dichlorodifluoromethane	75718		U075	5,000
1,1-Dichloroethane	75343		U076	1,000
1,2-Dichloroethane	107062		U077	100
1,1-Dichloroethylene	75354		U078	100
1,2-Dichloroethylene	156605		U079	1,000
Dichloroethyl ether	11444	10,000	U025	10
Dichloroisopropyl ether	108601		U027	1,000
Dichloromethoxy ethane	111911		U024	1,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Dichloromethyl ether	542881		P016	1
Dichloromethylphenylsilane	149746	1,000		1
2,4-Dichlorophenol	120832		U081	100
2,6-Dichlorophenol	87650		U082	100
Dichlorophenylarsine	696286		P036	1
Dichloropropane	26638197			1,000
1,1-Dichloropropane	78999			
1,3-Dichloropropane	142289			
1,2-Dichloropropane	78875		U083	1,000
Dichloropropane--Dichloropropene (mixture)	8003198			100
Dichloropropene	26952238			100
2,3-Dichloropropene	78886			
1,3-Dichloropropene	542756		U084	100
2,2-Dichloropropionic acid	75990			5,000
Dichlorvos	62737	1,000		10
Dicofol	115322			10
Dicrotophos	141662	100		1
Dieldrin	60571		P037	1
1,2:3,4-Diepoxybutane (I,T)	1464535	500	U085	10
Diethanolamine	111422			100
Diethyl chlorophosphate	814493	500		1
Diethylamine	109897			1,000
Diethylarsine	692422		P038	1
Diethylcarbmazine citrate	1642542	100/10,000		1
1,4-Diethylenedioxide	123911		U108	100
Diethylhexyl phthalate	117817		U028	100
N,N-Diethylaniline	91667			1,000
N,N'-Diethylhydrazine	1615801		U086	10
O,O-Diethyl S-methyl dithiophosphate	3288582		U087	5,000
Diethyl-p-nitrophenyl phosphate	311455		P041	100
Diethyl phthalate	84662		U088	1,000
O,O-Diethyl O-pyrazinyl phosphorothioate	297972		P040	100
Diethylstilbestrol	56531		U089	1
Diethyl sulfate	64675			10
Digitoxin	71636	100/10,000		1
Diglycidyl ether	2238075	1,000		1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Digoxin	20830755	10/10,000		1
Dihydrosafrole	94586		U090	10
Diisopropyfluorophosphate	55914		P043	100
Diisopropylfluorophosphate, 1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1-alpha, 4-alpha, 4a-beta, 5-alpha, 8-alpha, 8a-beta)-	309002		P004	1
1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro, (1-alpha, 4-alpha, 4a-beta, 5a-beta, 8-beta, 8a-beta)-	465736		P060	1
2,7:3,6-Dimethanonaphth[2,3 b]oxirene,3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,(1a-alpha, 2-beta, 2a-alpha, 3-beta, 6-beta, 6a-alpha, 7beta, 7aalpha)-	60571		P037	1
2,7:3,6 Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octa-hydro-, (1a-alpha, 2-beta, 2a-beta, 3-alpha, 6-alpha, 6a-beta, 7-beta, 7a-alpha)-	72208		P051	1
Dimethoate	60515		P044	10
3,3'-Dimethoxybenzidine	119904		U091	10
Dimefox	115264	500		1
Dimethoate	60515	500/10,000		10
Dimethyl Phosphorochloridothioate	2524030	500		1
Dimethyl sulfate	77781	500		100
Dimethylamine (I)	124403		U092	1,000
p-Dimethylaminoazobenzene	60117		U093	10
7,12-Dimethylbenz[a]anthracene	57976		U094	1
3,3'-Dimethylbenzidine	119937		U095	10
alpha,alpha-Dimethylbenzylhydroperoxide(R)	80159		U096	10
Dimethylcarbamoyl chloride	79447		U097	1
Dimethylformamide	68122			100
Dimethyldichlorosilane	75785	500		1
1,1-Dimethylhydrazine	57147	1,000	U098	10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
1,2-Dimethylhydrazine	540738		U099	1
alpha, alpha-Dimethylphenethylamine	122098		P046	5,000
Dimethyl-p-phenylenediamine	99989	10/10,000		1
2,4-Dimethylphenol	105679		U101	100
Dimethyl phthalate	131113		U102	5,000
Dimethyl sulfate	77781		U103	100
Dimetilan	644644	500/10,000		1
Dinitrobenzene (mixed)	25154545			100
m-Dinitrobenzene	99650			
o-Dinitrobenzene	528290			
p-Dinitrobenzene	100254			
4,6-Dinitro-o-cresol and salts	534521	10/10,000	P047	10
Dinitrophenol	25550587			10
2,5-Dinitrophenol	329715			
2,6-Dinitrophenol	573568			
2,4-Dinitrophenol	51285		P048	10
Dinitrotoluene	25321146			10
3,4-Dinitrotoluene	610399			
2,4-Dinitrotoluene	121142		U105	10
2,6-Dinitrotoluene	606202		U106	100
Dinoseb	88857	100/10,000	P020	1,000
Dinoterb	1420071	500/10,000		1
Di-n-octyl phthalate	117840		U107	5,000
1,4-Dioxane	123911		U108	100
Dioxathion	78342	500		1
Diphacinone	82666	10/10,000		1
1,2-Diphenylhydrazine	122667		U109	10
Diphosphoramide, octamethyl-	152169	100	P085	100
Diphosphoric acid, tetraethyl ester	107493		P111	10
Dipropylamine	142847		U110	5,000
Di-n-propylnitrosamine	621647		U111	10
Diquat	85007			1,000
	2764729			
Disulfoton	298044	500	P039	1
Dithiazanine iodide	514738	500/10,000		1
Dithiobiuret	541537	100/10,000	P049	100
Diuron	330541			100
Dodecylbenzenesulfonic acid	27176870			1,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Emetine, Dihydrochloride	316427	1/10,000		1
Endosulfan	115297	10/10,000	P050	1
alpha-Endosulfan	959988			1
beta-Endosulfan	33213659			1
Endosulfant sulfate	1031078			1
Endothall	145733		P088	1,000
Endothion	2778043	500/10,000		1
Endrin	72208	500/10,000	P051	1
Endrin aldehyde	7421934			1
Endrin & metabolites	72208		P051	1
Epichlorohydrin	106898	1,000	U041	100
Epinephrine	51434		P042	1,000
EPN	2104645	100/10,000		1
1,2-Epoxybutane	106887			100
Ergocalciferol	50146	1,000/10,000		1
Ergotamine tartrate	379793	500/10,000		1
Ethanal	75070		U001	1,000
Ethanamine, N-ethyl-N-nitroso-	55185		U174	1
1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-	91805		U155	5,000
Ethane, 1,2-dibromo-	106934		U067	1
Ethane, 1,1-dichloro-	75343		U076	1,000
Ethane, 1,2-dichloro-	107062		U077	100
Ethanedinitrile	460195		P031	100
Ethane, hexachloro-	67721		U131	100
Ethane, 1,1'-[methylenebis(oxy)]bis(2-chloro-	111911		U024	1,000
Ethane, 1,1'-oxybis-	60297		U117	100
Ethane, 1,1'-oxybis(2-chloro-	111444		U025	10
Ethane, pentachloro-	76017		U184	10
Ethanesulfonyl chloride, 2-chloro	1622328	500		1
Ethane, 1,1,1,2-tetrachloro-	630206		U208	100
Ethane, 1,1,2,2-tetrachloro-	79345		U209	100
Ethanethioamide	62555		U218	10
Ethane, 1,1,1-trichloro-	71556		U226	1,000
Ethane, 1,1,2-trichloro-	79005		U227	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Ethanimidothioic acid, N-[[(methylamino) carbonyl]oxy]-, methyl ester	16752775		P066	100
Ethanol, 1,2-Dichloro-, acetate	10140871	1,000		1
Ethanol, 2-ethoxy-	110805		U359	1,000
Ethanol, 2,2'-(nitrosoimino)bis-	1116547		U173	1
Ethanone, 1-phenyl-	98862		U004	5,000
Ethene, chloro-	75014		U043	1
Ethene, 2-chloroethoxy-	110758		U042	1,000
Ethene, 1,1-dichloro-	75354		U078	100
Ethene, 1,2-dichloro- (E)	156605		U079	1,000
Ethene, tetrachloro-	127184		U210	100
Ethene, trichloro-	79016		U228	100
Ethion	563122	1,000		10
Ethoprophos	13194484	1,000		1
Ethyl acetate (I)	141786		U112	5,000
Ethyl acrylate (I)	140885		U113	1,000
Ethylbenzene	100414			1,000
Ethylbis(2-Chloroethyl)amine	538078	500		1
Ethyl carbamate (urethane)	51796		U238	100
Ethyl chloride	75003			100
Ethyl cyanide	107120		P101	10
Ethylenebisdithiocarbamic acid, salts & esters	111546		U114	5,000
Ethylenediamine	107153			5,000
Ethylenediamine-tetraacetic acid (EDTA)	60004			5,000
Ethylene dibromide	106934		U067	1
Ethylene dichloride	107062		U077	100
Ethylene fluorohydrin	371620	10		1
Ethylene glycol	107211			5,000
Ethylene glycol monoethyl ether	110805		U359	1,000
Ethylene oxide (I,T)	75218	1,000	U115	10
Ethylenediamine	107153	10,000		5,000
Ethylenethiourea	96457		U116	10
Ethyleneimine	151564	500	P054	1
Ethyl ether (I)	60297		U117	100
Ethylthiocyanate	542905	10,000		1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Ethylidene dichloride	75343		U076	1,000
Ethyl methacrylate	97632		U118	1,000
Ethyl methanesulfonate	62500		U119	1
Famphur	52857		P097	1,000
Fenamlphos	22224926	10/10,000		1
Fenltrothion	122145	500		1
Fensulfothion	115902	500		1
Ferric ammonium citrate	1185575			1,000
Ferric ammonium oxalate	2944674			1,000
	55488874			
Ferric chloride	7705080			1,000
Ferric fluoride	7783508			100
Ferric nitrate	10421484			1,000
Ferric sulfate	10028225			1,000
Ferrous ammonium sulfate	10045893			1,000
Ferrous chloride	7758943			100
Ferrous sulfate	7720787			1,000
	7782630			
Fluenetil	4301502	100/10,000		1
Fluoranthene	206440		U120	100
Fluorene	86737			5,000
Fluorine	7782414	500	P056	10
Fluoroacetamide	640197	100/10,000	P057	100
Fluoracetic acid	144490	10/10,000		1
Fluoroacetic acid, sodium salt	62786		P058	10
Fluoroacetyl chloride	359068	10		1
Fluorouracil	51218	500/10,000		1
Fonofos	944229	500		1
Formaldehyde	50000	500	U122	100
Formaldehyde cyanohydrin	107164	1,000		1
Formetanate hydrochloride	23422539	500/10,000		1
Formothion	2540821	100		1
Formparanate	17702577	100/10,000		1
Formic acid (C,T)	64186		U123	5,000
Fosthletan	21548323	500		1
Fubendazole	3878191	100/10,000		1
Fulminic acid, mercury(2$^-$) salt (R,T)	628864		P065	10
Fumaric acid	110178			5,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Furan (I)	110009	500	U124	100
Furan, tetrahydro- (I)	109999		U213	1,000
2-Furancarboxaldehyde (I)	98011		U125	5,000
2,5-Furandione	108316		U147	5,000
Furfural (I)	98011		U125	5,000
Furfuran (I)	110009		U124	100
Gallium trichloride	13450903	500/10,000		1
Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-	18883664		U206	1
D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)-carbonyl]amino]-	18883664		U206	1
Glycidylaldehyde	765344		U126	10
Guanidine, N-methyl-N'-nitro-N-nitroso-	70257		U163	10
Guthion	86500			1
Heptachlor	76448		P059	1
Heptachlor epoxide	1024573			1
Hexachlorobenzene	118741		U127	10
Hexachlorobutadiene	87683		U128	1
Hexachlorocyclohexane (gamma isomer)	58899		U129	1
Hexachlorocyclopentadiene	77474	100	U130	10
Hexachloroethane	67721		U131	100
Hexachlorophene	70304		U132	100
Hexachloropropene	1888717		U243	1,000
Hexaethyl tetraphosphate	757584		P062	100
Hexamethylene-1, 6-diisocyanate	822060			100
Hexamethylphosphoramide	680319			1
Hexamethylenediamine, N,N'-Dibutyl	4835114	500		1
Hexane	110543			5,000
Hexone (Methyl isobutyl ketone)	108101		U161	5,000
Hydrazine (R,T)	302012	1,000	U133	1
Hydrazine, 1,2-diethyl-	1615801		U086	10
Hydrazine, 1,1-dimethyl-	57147		U098	10
Hydrazine, 1,2-dimethyl-	540738		U099	1
Hydrazine, 1,2-diphenyl-	122667		U109	10
Hydrazine, methyl-	60344		P068	10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Hydrazinecarbothioamide	79196		P116	100
Hydrochloric acid	7647010			5,000
Hydrocyanic acid	74908	100	P063	10
Hydrofluoric acid	7664393		U134	100
Hydrogen chloride (gas only)	7647010	500		5,000
Hydrogen cyanide	74908		P063	10
Hydrogen fluoride	7664393	100	U134	100
Hydrogen peroxide (Conc. >52%)	7722841	1,000		1
Hydrogen phosphide	7803512		P096	100
Hydrogen selenide	7783075	10		1
Hydrogen sulfide	7783064	500	U135	100
Hydroperoxide, 1-methyl-1-phenylethyl-	80159		U096	10
Hydroquinone	123319	500/10,000		100
2-Imidazolidinethione	96457		U116	10
Indeno(1,2,3-cd)pyrene	193395		U137	100
Iodomethane	74884		U138	100
Iron, Pentacarbonyl-	13463406	100		1
Isobenzan	297789	100/10,000		1
1,3-Isobenzofurandione	85449		U190	5,000
Isobutyronitrile	78820	1,000		1
Isobutyl alcohol (I,T)	78831		U140	5,000
Isocyanic acid, 3,4-Dichlorophenyl ester	102363	500/10,000		1
Isodrin	465736	100/10,000	P060	1
Isofluorphate	55914	100		100
Isophorone	78591			5,000
Isophorone Diisocyanate	4098719	100		1
Isoprene	78795			100
Isopropanolamine dodecylbenzene sulfonate	42504461			1,000
Isopropyl chloroformate	108236	1,000		1
Isopropylmethylpryrazolyl dimethylcarbamate	119380	500		1
Isosafrole	120581		U141	100
3(2H)-Isoxazolone, 5-(aminomethyl)-	2763964		P007	1,000
Kepone	143500		U142	1
Lactonitrile	78977	1,000		1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Lasiocarpine	303344		U143	10
Lead acetate	301042		U144	#
Lead arsenate	7784409			1
	7645252			
	10102484			
Lead, bis(acetato-O)tetrahydroxytri	1335326		U146	10
Lead chloride	7758954			10
Lead fluoborate	13814965			10
Lead fluoride	7783462			10
Lead iodide	10101630			10
Lead nitrate	10099748			10
Lead phosphate	7446277		U145	10
Lead stearate	7428480			10
	1072351			
	52652592			
	56189094			
Lead subacetate	1335326		U146	10
Lead sulfate	15739807			10
	7446142			
Lead sulfide	1314870			10
Lead thiocyanate	592870			10
Leptophos	21609905	500/10,000		1
Lewisite	541253	10		1
Lindane	58899	1,000/10,000	U129	1
Lithium chromate	14307358			10
Lithium hydride	7580678	100		1
Malathion	121755			100
Maleic acid	110167			5,000
Maleic anhydride	108316		U147	5,000
Maleic hydrazide	123331		U148	5,000
Malononitrile	109773	500/10,000	U149	1,000
Manganese, tricarbonyl methylcyclopentadienyl	12108133	100		1
MDI (Methylene diphenyl diisocyanate)	101688			5,000
Mechlorethamine	51752	10		1
MEK (Methyl ethyl ketone)	78933		U159	5,000
Melphalan	148823		U150	1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Mephosfolan	950107	500		1
Mercaptodimethur	2032657			10
Mercuric acetate	1600277	500/10,000		1
Mercuric chloride	7487947	500/10,000		1
Mercuric cyanide	592041			1
Mercuric nitrate	10045940			10
Mercuric oxide	21908532	500/10,000		1
Mercuric sulfate	7783359			10
Mercuric thiocyanate	592858			10
Mercurous nitrate	10415755			10
	7782867			
Mercury	7439976		U151	1
Mercury (acetate-O)phenyl-	62384		P092	100
Mercury fulminate	628864		P065	10
Methacrolein diacetate	10476956	1,000		1
Methacrylic anhydride	760930	500		1
Methacrylonitrile (I,T)	126987	500	U152	1,000
Methacryloyl chloride	920467	100		1
Methacryloyloxyethyl isocyanate	30674807	100		1
Methamidophos	10265926	100/10,000		1
Methanamine, N-methyl-	124403		U092	1,000
Methanamine, N-methyl-N-nitroso-	62759		P082	10
Methane, bromo-	74839		U029	1,000
Methane, chloro- (I,T)	74873		U045	100
Methane, chloromethoxy-	107302		U046	1
Methane, dibromo-	74953		U068	1,000
Methane, dichloro-	75092		U080	1,000
Methane, dichlorodifluoro-	75718		U075	5,000
Methane, iodo-	74884		U138	100
Methane, isocyanato-	624839		P064	10
Methane, oxybis(chloro-	542881		P016	1
Methanesulfenyl chloride, trichloro-	594423		P118	100
Methanesulfonyl fluoride	558258	1,000		1
Methanesulfonic acid, ethyl ester	62500		U119	1
Methane, tetrachloro-	56235		U211	10
Methane, tetranitro- (R)	509148		P112	10
Methane, tribromo-	75252		U225	100
Methane, trichloro-	67663		U044	10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Methane, trichlorofluoro-	75694		U121	5,000
Methanethiol (I,T)	74931		U153	100
6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10, 10-hexa-chloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide	115297		P050	1
1,3,4-Metheno-2H-cyclobutal[cd]pentalen-2-one,1,1a,3,3a,4,5,5a,5b,6-decachloroctahydro-	143500		U142	1
4,7-Methano-1H-indene, 1,4,5,6,7,8,8 heptachloro-3a,4,7,7a-tetrahydro-	76448		P059	1
4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8 octachloro-2,3,3a,4,7,7a-hexahydro-	57749		U036	1
Methanol (I)	67561		U154	5,000
Methapyrilene	91805		U155	5,000
Methidathion	950378	500/10,000		1
Methiocarb	2032657	500/10,000	P199	10
Methomyl	16752775	500/10,000	P066	100
Methoxychlor	72435		U247	1
Methoxyethylmercuric acetate	151382	500/10,000		1
Methyl alcohol (I)	67561		U154	5,000
Methyl aziridine	75558		P067	1
Methyl bromide	74839	1,000	U029	1,000
1-Methylbutadiene (I)	504609		U186	100
Methyl chloride (I,T)	74873		U045	100
Methyl 2-chloroacrylate	80637	500		1
Methyl chlorocarbonate (I,T)	79221		U156	1,000
Methyl chloroform	71556		U226	1,000
Methyl chloroformate	79221	500	U156	1,000
3-Methylcholanthrene	56495		U157	10
4,4'-Methylenebis(2-chloroaniline)	101144		U158	10
Methylene bromide	74953		U068	1,000
Methylene chloride	75092		U080	1,000
4,4’-Methylenedianiline	101779			10
Methylene diphenyl diisocyanate (MDI)	101688			5,000
Methyl ethyl ketone (MEK) (I,T)	78933		U159	5,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Methyl ethyl ketone peroxide (R,T)	1338234		U160	10
Methyl hydrazine	60344	500	P068	10
Methyl iodide	74884		U138	100
Methyl isobutyl ketone	108101		U161	5,000
Methyl isocyanate	624839	500	P064	10
Methyl isothiocyanate	556616	500		1
2-Methyllactonitrile	75865		P069	10
Methyl mercaptan	74931	500	U153	100
Methyl methacrylate (I,T)	80626		U162	1,000
Methyl parathion	298000		P071	100
Methyl phenkapton	3735237	500		1
Methyl phosphonic dichloride	676971	100		1
4-Methyl-2-pentanone (I)	108101		U161	5,000
Methyl tert-butyl ether	1634044			1,000
Methyl thiocyanate	556649	10,000		1
Methylthiouracil	56042		U164	10
Methyl vinyl ketone	78944	10		1
Methylmercuric dicyanamide	502396	500/10,000		1
Methyltrichlorosilane	75796	500		1
Metolcarb	1129415	100/10,000		1
Mevinphos	7786347	500		10
Mexacarbate	315184	500/10,000		1,000
Mitomycin C	50077	500/10,000	U010	10
MNNG	70257		U163	10
Monocrotophos	6923224	10/10,000		1
Monoethylamine	75047			100
Monomethylamine	74895			100
Muscimol	2763964	500/10,000	P007	1,000
Mustard gas	505602	500		1
Naled	300765			10
5,12-Naphthaacenedione, 8-acetyl-10-[3 amino-2,3,6-tri-deoxy-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-	20830813		U059	10
1-Naphthalenamine	134327		U167	100
2-Naphthalenamine (beta-Naphthylamine)	91598		U168	1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Naphthalenamine, N,N'-bis(2-chloroethyl)-	494031		U026	100
Naphthalene	91203		U165	100
Naphthalene, 2-chloro-	91587		U047	5,000
1,4-Naphthalenedione	130154		U166	5,000
2,7-Naphthalenedisulfonic acid, 3,3' [(3,3'-dimethyl-(1,1'-biphenyl)-4,4'-dryl)-bis(azo)] bis(5-amino-4-hydroxy)-tetrasodium salt	72571		U236	10
Naphthenic acid	1338245			100
1,4-Naphthoquinone	130154		U166	5,000
alpha-Naphthylamine	134327		U167	100
beta-Naphthylamine (2-Naphthalenamine)	91598		U168	1
alpha-Naphthylthiourea	86884		P072	100
Nickel++	7440020			100
Nickel ammonium sulfate	15699180			100
Nickel carbonyl	13463393	1	P073	10
Nickel carbonyl Ni(CO)4, (T-4)-	13463393		P073	10
Nickel chloride	7718549			100
	37211055			
Nickel cyanide	557197		P074	10
Nickel hydroxide	12054487			10
Nickel nitrate	14216752			100
Nickel sulfate	7786814			100
Nicotine & salts	54115	100	P075	100
Nicotine sulfate	65305	100/10,000		1
Nitric acid	7697372	1,000		1,000
Nitric acid, thallium(1+) salt	10102451		U217	100
Nitric oxide	10102439	100	P076	10
p-Nitroaniline	100016		P077	5,000
Nitrobenzene (I,T)	98953	10,000	U169	1,000
4-Nitrobiphenyl	92933			10
Nitrocyclohexane	1122607	500		1
Nitrogen dioxide	10102440	100	P078	10
	10544726			
Nitrogen oxide	10102439		P076	10
Nitroglycerine	55630		P081	10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Nitrophenol (mixed)	25154556			100
m-Nitrophenol	554847			100
o-Nitrophenol (2)	88755			100
p-Nitrophenol (4)	100027		U170	100
2-Nitropropane (I,T)	79469		U171	10
N-Nitrosodi-n-butylamine	924163		U172	10
N-Nitrosodiethanolamine	1116547		U173	1
N-Nitrosodiethylamine	55185		U174	1
N-Nitrosodimethylamine	62759	1,000	P082	10
N-Nitrosodiphenylamine	86306			100
N-Nitroso-N-ethylurea	759739		U176	1
N-Nitroso-N-methylurea	684935		U177	1
N-Nitroso-N-methylurethane	615532		U178	1
N-Nitrosomethylvinylamine	4549400		P084	10
N-Nitrosomorpholine	59892			1
N-Nitrosopiperidine	100754		U179	10
N-Nitrosopyrrolidine	930552		U180	1
Nitrotoluene	1321126			1,000
m-Nitrotoluene	99081			
o-Nitrotoluene	88722			
p-Nitrotoluene	99990			
5-Nitro-o-toluidine	99558		U181	100
Norbromide	991424	100/10,000		1
Octamethylpyrophosphoramide	152169		P085	100
Organorhodium complex (PMN-82-147)	0	10/10,000		1
Osmium tetroxide	20816120		P087	1,000
Ouabain	630604	100/10,000		1
7-Oxabicyclo[2,2,1]heptane-2,3-dicarboxylic acid	145733		P088	1,000
Oxamyl	23135220	100/10,000	P194	1
1,2-Oxathiolane, 2,2-dioxide	1120714		U193	10
2H-1,3,2-Oxazaphosphorin-2-amine, N,N bis (2-chloroethyl)tetrahydro-, 2-oxide	50180		U058	10
Oxetane, 3,3-bis(chloromethyl)-	78717	500		1
Oxirane (I,T)	75218		U115	10
Oxiranecarboxyaldehyde	765344		U126	10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Oxirane, (chloromethyl)-	106898		U041	100
Oxydisulfoton	2497076	500		1
Ozone	10028156	100		1
Paraformaldehyde	30525894			1,000
Paraldehyde	123637		U182	1,000
Paraquat	1910425	10/10,000		1
Paraquat methosulfate	2074502	10/10,000		1
Parathion	56382	100	P089	10
Parathion-methyl	298000	100/10,000		100
Paris green	12002038	500/10,000		100
PCBs	1336363			
Aroclor 1016	12674112			1
Aroclor 1221	11104282			1
Aroclor 1232	11141165			1
Aroclor 1242	53469219			1
Aroclor 1248	12672296			1
Aroclor 1254	11097691			1
Aroclor 1260	11096825			1
PCNB (Pentachloronitrobenzene)	82688		U185	100
Pentaborane	19624227	500		1
Pentachlorobenzene	608935		U183	10
Pentachloroethane	76017		U184	10
Pentachlorophenol	87865		U242	10
Pentachloronitrobenzene (PCNB)	82688		U185	100
Pentadecylamine	2570265	100/10,000		1
Paracetic acid	79210	500		1
1,3-Pentadiene (I)	504609		U186	100
Perachloroethylene	127184		U210	100
Perchloromethylmercaptan	594423	500		100
Phenacetin	62442		U187	100
Phenanthrene	85018			5,000
Phenol	108952	500/10,000	U188	1,000
Phenol, 2-chloro-	95578		U048	100
Phenol, 4-chloro-3-methyl-	59507		U039	5,000
Phenol, 2-cyclohexyl-4,6-dinitro-	131895		P034	100
Phenol, 2,4-dichloro-	120832		U081	100
Phenol, 2,6-dichloro-	87650		U082	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)	56531		U089	1
Phenol, 2,4-dimethyl-	105679		U101	100
Phenol, 2,4-dinitro-	51285		P048	10
Phenol, methyl-	1319773		U052	1,000
m-Cresol	108394			
o-Cresol	95487			
p-Cresol	106445			
Phenol, 2-methyl-4,6-dinitro-and salts	534521		P047	10
Phenol, 2,2'-methylenebis[3,4,6-trichloro-	70304		U132	100
Phenol, 2,2'-thiobis(4-chloro-6-methyl)-	4418660	100/10,000		1
Phenol, 2-(1-methylpropyl)-4,6-dinitro	88857		P020	1,000
Phenol, 3-(1-methylethyl)-, methylcarbamate	64006	500/10,000		1
Phenol, 4-nitro-	100027		U170	100
Phenol, pentachloro-	87865		U242	10
Phenol, 2,3,4,6-tetrachloro-	58902		U212	10
Phenol, 2,4,5-trichloro-	95954		U230	10
Phenol, 2,4,6-trichloro-	88062		U231	10
Phenol, 2,4,6-trinitro-, ammonium salt	131748		P009	10
Phenoxarsine, 10,10'-oxydi-	58366	500/10,000		1
L-Phenylalanine, 4-[bis(2-chloroethyl)aminol]	148823		U150	1
Phenyl dichloroarsine	696286	500		1
1,10-(1,2-Phenylene)pyrene	193395		U137	100
p-Phenylenediamine	106503			5,000
Phenylhydrazine hydrochloride	59881	1,000/10,000		1
Phenylmercury acetate	62384	500/10,000	P092	100
Phenylsilatrane	2097190	100/10,000		1
Phenylthiourea	103855	100/10,000	P093	100
Phorate	298022	10	P094	10
Phosacetim	4104147	100/10,000		1
Phosfolan	947024	100/10,000		1
Phosgene	75445	10	P095	10
Phosmet	732116	10/10,000		1
Phosphamidon	13171216	100		1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Phosphine	7803512	500		100
Phosphorothioic acid, o,o-Dimethyl-s (2-Methylthio) ethyl ester	2587908	500		1
Phosphorothioic acid, methyl-, o-ethyl o-(4-(methylthio)phenyl) ester	2703131	500		1
Phosphorothioic acid, methyl-, s-(2-(bis(1-methylethyl)amino)ethyl o-ethyl ester	50782699	100		1
Phosphorothioic acid, methyl-, 0-(4-nitrophenyl) o-phenyl ester	2665307	500		1
Phosphoric acid	7664382			5,000
Phosphoric acid, diethyl 4-nitrophenyl ester	311455		P041	100
Phosphoric acid, dimethyl 4-(methylthio) phenyl ester	3254635	500		1
Phosphoric acid, lead(2+) salt (2:3)	7446277	500	U145	10
Phosphorodithioic acid, O,O-diethyl S-[2 (ethylthio)ethyl]ester	298044		P039	1
Phosphorodithioic acid, O,O-diethyl S-(ethylthio), methyl ester	298022		P094	10
Phosphorodithioic acid, O,O-diethyl S-methyl ester	3288582		U087	5,000
Phosphorodithoic acid, O,O-dimethyl S-[2(methyl-amino)-2-oxoethyl] ester	60515		P044	10
Phosphorofluondic acid, bis(1-methylethyl) ester	55914		P043	100
Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester	56382		P089	10
Phosphorothioic acid, O,[4-[(dime-thylamino)sulfonyl]phenyl]O,O-dimethyl ester	52857		P097	1,000
Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester	298000		P071	100
Phosphorothioic acid, 0,0-diethyl 0 pyrazinyl ester	297972		P040	100
Phosphorus	7723140	100		1
Phosphorus oxychloride	10025873	500		1,000
Phosphorous pentachloride	10026138	500		1
Phosphorus pentasulfide (R)	1314803		U189	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Phosphorus pentoxide	1314563	10		1
Phosphorus trichloride	7719122	1,000		1,000
Phthalic anhydride	85449		U190	5,000
Physostigmine	57476	100/10,000	P204	1
Phosostigmine, salicylate (1:1)	57647	100/10,000		1
2-Picoline	109068		U191	5,000
Picotoxin	124878	500/10,000		1
Piperidine	110894	1,000		1
Piperidine, 1-nitroso-	100754		U179	10
Pirimifos-ethyl	23505411	1,000		1
Plumbane, tetraethyl-	78002		P110	10
Polychlorinated biphenyls (See PCBs or Aroclor)	1336363			1
Potassium arsenate	7784410			1
Potassium arsenite	10124502	500/10,000		1
Potassium bichromate	7778509			10
Potassium chromate	7789006			10
Potassium cyanide	151508	100	P098	10
Potassium hydroxide	1310583			1,000
Potassium permanganate	7722647			100
Potassium silver cyanide	506616	500	P099	1
Promecarb	2631370	500/10,000		1
Pronamide	23950585		U192	5,000
Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime	116063		P070	1
1-Propanamine (I,T)	107108		U194	5,000
1-Propanamine, N-propyl-	142847		U110	5,000
1-Propanamine, N-nitroso-N-propyl-	621647		U111	10
Propane, 1,2-dibromo-3-chloro	96128		U066	1
Propane, 2-nitro- (I,T)	79469		U171	10
1,3-Propane sultone	1120714		U193	10
Propane 1,2-dichloro-	78875		U083	1,000
Propanedinitrile	109773		U149	1,000
Propanenitrile	107120		P101	10
Propanenitrile, 3-chloro-	542767		P027	1,000
Propanenitrile, 2-hydroxy-2-methyl-	75865		P069	10
Propane, 2,2'-oxybis[2-chloro-	108601		U027	1,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
1,2,3-Propanetnol, trinitrate- (R)	55630		P081	10
1-Propanol, 2,3-dibromo-, phosphate (3:1)	126727		U235	10
1-Propanol, 2-methyl- (I,T)	78831		U140	5,000
2-Propanone (I)	67641		U002	5,000
2-Propanone, 1-bromo-	598312		P017	1,000
Propargite	2312358			10
Propargyl alcohol	107197		P102	1,000
Propargyl bromide	106967	10		1
2-Propenal	107028		P003	1
2-Propenamide	79061		U007	5,000
1-Propene, 1,1,2,3,3,3-hexachloro-	1888717		U243	1,000
1-Propene, 1,3-dichloro-	542756		U084	100
2-Propenenitrile	107131		U009	100
2-Propenenitrile, 2-methyl- (I,T)	126987		U152	1,000
2-Propenoic acid (I)	79107		U008	5,000
2-Prepenoic acid, ethyl ester (I)	140885		U113	1,000
2-Prepenoic acid, 2-methyl-, ethyl ester	97632		U118	1,000
2-Prepenoic acid, 2-methyl-, methyl ester (I,T)	80626		U162	1,000
2-Propen-1-o1	107186		P005	100
Propiolactone, beta-	57578	500		1
Propionaldehyde	123386			1,000
Propionic acid	79094			5,000
Propionic acid, 2-(2,4,5-trichlorophenoxyl)-	93721		U233	100
Propionic anhydride	123626			5,000
Propoxor (Baygon)	114261		U411	100
Propionitrile	107120	500		10
Propionitrile, 3-chloro-	542767	1,000		1,000
Propiophenone, 1, 4-amino phenyl	70699	100/10,000		1
n-Propylamine	107108		U194	5,000
Propyl chloroformate	109615	500		1
Propylene dichloride	78875		U083	1,000
Propylene oxide	75569	10,000		100
1,2-Propylenimine	75558	10,000	P067	1
2-Propyn-1-o1	107197		P102	1,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Prothoate	2275185	100/10,000		1
Pyrene	129000	1,000/10,000		5,000
Pyrethrins	121299			1
	121211			
	8003347			
3,6-Pyridazinedione, 1,2-dihydro-	123331		U148	5,000
4-Pyridinamine	504245		P008	1,000
Pyridine	110861		U196	1,000
Pyridine, 2-methyl-	109068		U191	5,000
Pyridine, 2-methyl-5-vinyl-	140761	500		1
Pyridine, 4-amino-	504245	500/10,000		1,000
Pyridine, 4-nitro-, 1-oxide	1124330	500/10,000		1
Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)	54115		P075	100
2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-	66751		U237	10
4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-	56042		U164	10
Pyriminil	53558251	100/10,000		1
Pyrrolidine, 1-nitroso-	930552		U180	1
Quinoline	91225			5,000
Quinone (p-Benzoquinone)	106514		U197	10
Quintobenzene	82688		U185	100
Reserpine	50555		U200	5,000
Resorcinol	108463		U201	5,000
Saccharin and salts	81072		U202	100
Salcomine	14167181	500/10,000		1
Sarin	107448	10		1
Safrole	94597		U203	100
Selenious acid	7783008	1,000/10,000	U204	10
Selenious acid, dithallium (1+) salt	12039520		P114	1,000
Selenium ++	7782492			100
Selenium dioxide	7446084		U204	10
Selenium oxychloride	7791233	500		1
Selenium sulfide (R,T)	7488564		U205	10
Selenourea	630104		P103	1,000
Semicarbazide hydrochloride	563417	1,000/10,000		1
L-Serine, diazoacetate (ester)	115026		U015	1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Silane, (4-aminobutyl)diethoxymethyl-	3037727	1,000		1
Silver ++	7440224			1,000
Silver cyanide	506649		P104	1
Silver nitrate	7761888			1
Silvex (2,4,5-TP)	93721		U233	100
Sodium	7440235			10
Sodium arsenate	7631892	1,000/10,000		1
Sodium arsenite	7784465	500/10,000		1
Sodium azide	26628228	500	P105	1,000
Sodium bichromate	10588019			10
Sodium bifluoride	1333831			100
Sodium bisulfite	7631905			5,000
Sodium cacodylate	124652	100/10,000		1
Sodium chromate	7775113			10
Sodium cyanide	143339	100	P106	10
Sodium dodecylbenzenesulfonate	25155300			1,000
Sodium fluoride	7681494			1,000
Sodium fluoroacetate	62748	10/10,000		10
Sodium hydrosulfide	16721805			5,000
Sodium hydroxide	1310732			1,000
Sodium hypochlorite	7681529			100
	10022705			
Sodium methylate	124414			1,000
Sodium nitrite	7632000			100
Sodium prentachlorophenate	131522	100/10,000		1
Sodium phosphate, dibasic	7558794			5,000
	10039324			
	10140655			
Sodium phosphate, tribasic	7601549			5,000
	7758294			
	7785844			
	10101890			
	10124568			
	10361894			
Sodium selenate	13410010	100/10,000		1
Sodium selenite	10102188	100/10,000		100
	7782823			

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Sodium tellurite	10102202	500/10,000		1
Stannane, acetoxytriphenyl	900958	500/10,000		1
Streptozotocin	18883664		U206	1
Strontium chromate	7789062			10
Strychnidin-10-one	57249		P108	10
Strychnidin-10-one, 2,3-dimethoxy-	357573		P018	100
Strychnine, & salts	572494	100/10,000	P108	10
Strychnine sulfate	60413	100/10,000		1
Styrene	100425			1,000
Styrene oxide	96093			100
Sulfotep	3689245	500		100
Sulfoxide, 3-chloropropyl octyl	3569571	500		1
Sulfur monochloride	12771083			1,000
Sulfur dioxide	7446095	500		1
Sulfur phosphide (R)	1314803		U189	100
Sulfur tetrafluoride	7783600	100		1
Sulfur trioxide	7446119	100		1
Sulfuric acid	7664939	1,000		1,000
	8014957			
Sulfuric acid, dithallium (1+) salt	7446186		P115	100
	10031591			
Sulfuric acid, dimethyl ester	77781		U103	100
Tabun	77816	10		1
2,4,5-T acid	93765		U232	1,000
2,4,5-T amines	2008460			5,000
	1319728			
	3813147			
	6369966			
	6369977			
Tellurium	13494809	500/10,000		1
Tellurium hexafluoride	7783804	100		1
2,4,5-T esters	93798			1,000
	1928478			
	2545597			
	25168154			
	61792072			
2,4,5-T salts	13560991			1,000
2,4,5-T	93765		U232	1,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
TDE (Dichloro diphenyl dichloroethane)	72548		U060	1
TEPP (Tetraethyl ester diphosphoric acid)	107493	100		10
Terbufos	13071799	100		1
1,2,4,5-Tetrachlorobenzene	95943		U207	5,000
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746016			1
1,1,1,2-Tetrachloroethane	630206		U208	100
1,1,2,2-Tetrachloroethane	79345		U209	100
Tetrachloroethene	127184		U210	100
Tetrachloroethylene	127184		U210	100
2,3,4,6-Tetrachlorophenol	58902		U212	10
Tetraethyl lead	78002	100	P110	10
Tetraethyl pyrophosphate	107493		P111	10
Tetraethyldithiopyrophosphate	3689245		P109	100
Tetraethyltin	597648	100		1
Tetramethyllead	75741	100		1
Tetrahydrofuran (I)	109999		U213	1,000
Tetranitromethane (R)	509148	500	P112	10
Tetraphosphoric acid, hexaethyl ester	757584		P062	100
Thallic oxide	1314325		P113	100
Thallium ++	7440280			1,000
Thallium acetate	563688		U214	100
Thallium carbonate	6533739		U215	100
Thallium chloride	7791120		U216	100
Thallium nitrate	10102451		U217	100
Thallium oxide	1314325		P113	100
Thallium selenite	12039520		P114	1,000
Thallium sulfate	7446186	100/10,000	P115	100
	10031591			
Thallous carbonate (Thallium (I) carbonate)	6533739	100/10,000	U215	100
Thallous chloride (Thallium (I) chloride)	7791120	100/10,000	U216	100
Thallous malonate (Thallium (I) malonate)	2757188	100/10,000		1
Thallous sulfate (Thallium (I) sulfate)	7446186	100/10,000	P115	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Thioacetamide	62555		U218	10
Thiocarbazide	2231574	1,000/10,000		1
Thiodiphosphoric acid, tetraethyl ester	3689245		P109	100
Thiofanox	39196184	100/10,000	P045	100
Thioimidodicarbonic diamide [(H2N)C(S)] 2NH	541537		P049	100
Thiomethanol (I,T)	74931		U153	100
Thionazin	297972	500		100
Thioperoxydicarbonic diamide [(H2N)C(S)] 2S2, tetra-methyl-	137268		U244	10
Thiophenol	108985	500	P104	100
Thiosemicarbazide	79196	100/10,000	P116	100
Thiourea	62566		U219	10
Thiourea, (2-chlorophenyl)-	5344821	100/10,000	P026	100
Thiourea, (2-methylphenyl)-	614788	500/10,000		1
Thiourea, 1-naphthalenyl-	86884		P072	100
Thiourea, phenyl-	103855		P093	100
Thiram	137268		U244	10
Titanium tetrachloride	7550450	100		1,000
Toluene	108883		U220	1,000
Toluenediamine	95807		U221	10
	496720			
	823405			
	25376458			
Toluene diisocyanate (R,T)	584849	500	U223	100
	91087	100		100
	26471625			
o-Toluidine	95534		U328	100
p-Toluidine	106490		U353	100
o-Toluidine hydrochloride	636215		U222	100
Toxaphene	8001352		P123	1
2,4,5-TP acid	93721		U233	100
2,4,5-TP acid esters	32534955			100
1H-1,2,4-Triazol-3-amine	61825		U011	10
Trans-1,4-dichlorobutene	110576	500		1
Triamiphos	1031476	500/10,000		1
Triazofos	24017478	500		1
Trichloroacetyl chloride	76028	500		1

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Trichlorfon	52686			100
1,2,4-Trichlorobenzene	120821			100
1,1,1-Trichloroethane	71556		U226	1,000
1,1,2-Trichloroethane	79005		U227	100
Trichloroethene	79016		U228	100
Trichloroethylene	79016		U228	100
Trichloroethylsilane	115219	500		1
Trichloronate	327980	500		1
Trichloromethanesulfenyl chloride	594423		P118	100
Trichloromonofluoromethane	75694		U121	5,000
Trichlorophenol	21567822			10
2,3,4-Trichlorophenol	15950660			
2,3,5-Trichlorophenol	933788			
2,3,6-Trichlorophenol	933755			
2,4,5-Trichlorophenol	95954		U230	10
2,4,6-Trichlorophenol	88062		U231	10
3,4,5-Trichlorophenol	609198			
Trichlorophenylsilane	98135	500		1
Trichloro(chloromethyl)silane	1558254	100		1
Trichloro(dichlorophenyl)silane	27137855	500		1
Triethanolamine dodecylbenzene-sulfonate	27323417			1,000
Triethoxysilane	998301	500		1
Trifluralin	1582098			10
Triethylamine	121448			5,000
Trimethylamine	75503			100
Trimethylchlorsilane	75774	1,000		1
2,2,4-Trimethylpentane	540841			1,000
Trimethylolpropane phosphite	824113	100/10,000		1
Trimethyiltin chloride	1066451	500/10,000		1
1,3,5-Trinitrobenzene (R,T)	99354		U234	10
1,3,5-Trioxane, 2,4,6-trimethyl-	123637		U182	1,000
Triphenyltin chloride	639587	500/10,000		1
Tris(2-chloroethyl)amine	555771	100		1
Tris(2,3-dibromopropyl) phosphate	126727		U235	10
Trypan blue	72571		U236	10
Unlisted Hazardous Wastes Characteristic of **Ignitability**	NA		D001	100

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Unlisted Hazardous Wastes Characteristic of **Corrosivity**	NA		D002	100
Unlisted Hazardous Wastes Characteristic of **Reactivity**	NA		D003	100
Unlisted Hazardous Wastes Characteristic of **Toxicity**				

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Arsenic			D004	1
Barium			D005	1,000
Benzene			D018	10
Cadmium			D006	10
Carbon Tetrachloride			D019	10
Chlordane			D020	1
Chlorobenzene			D021	100
Chloroform			D022	10
Chromium			D007	10
o-Cresol			D023	100
m-Cresol			D024	100
p-Cresol			D025	100
Cresol			D026	100
2,4-D (Dichlorophenoxyacetic acid)			D016	100
1,4-Dichlorobenzene			D027	100
1,2-Dichloroethane			D028	100
1,1-Dichloroethylene			D029	100
2,4-Dinitrotoluene			D030	10
Endrin			D012	1
Heptachlor (and epoxide)			D031	1
Hexachlorobenzene			D032	10
Hexachlorobutadiene			D033	1
Hexachloroethane			D034	100
Lead			D008	10
Lindane			D013	1
Mercury			D009	1
Methoxychlor			D014	1
Methyl ethyl ketone			D035	5,000
Nitrobenzene			D036	1,000
Pentachlorophenol			D037	10
Pyridine			D038	1,000
Selenium			D010	10
Silver			D011	1
Tetrachloroethylene			D039	100
Toxaphene			D015	1
Trichloroethylene			D040	100
2,4,5 Trichlorophenol			D041	10

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
2,4,5-TP			D017	100
Vinyl chloride			D043	1
Uracil mustard	66751		U237	10
Uranyl acetate	541093			100
Uranyl nitrate	10102064			100
	36478769			
Urea, N-ethyl-N-nitroso	759739		U176	1
Urea, N-methyl-N-nitroso	684935		U177	1
Urethane (Carbamic acid ethyl ester)	51796		U238	100
Valinomycin	2001958	1,000/10,000		1
Vanadic acid, ammonium salt	7803556		P119	1,000
Vanadic oxide V_20_5	1314621		P120	1,000
Vanadic pentoxide	1314621		P120	1,000
Vanadium pentoxide	1314621	100/10,000		1,000
Vanadyl sulfate	27774136			1,000
Vinyl chloride	75014		U043	1
Vinyl acetate	108054			5,000
Vinyl acetate monomer	108054	1,000		5,000
Vinylamine, N-methyl-N-nitroso-	4549400		P084	10
Vinyl bromide	593602			100
Vinylidene chloride	75354		U078	100
Warfarin, & salts, when present at concentrations greater than 0.3%	81812	500/10,000	P001	100
Warfarin sodium	129066	100/10,000		100
Xylene (mixed)	1330207		U239	100
m-Benzene, dimethyl	108383			1,000
o-Benzene, dimethyl	95476			1,000
p-Benzene, dimethyl	106423			100
Xylenol	1300716			1,000
Xylylene dichloride	28347139	100/10,000		1
Yohimban-16-carboxylic acid, 11,17 dimethoxy-18-[(3,4,5-trimethoxy-benzoyl)oxy]-, methyl ester (3-beta, 16-beta,17-alpha,18-beta,20-alpha)-	50555		U200	5,000
Zinc ++	7440666			1,000
Zinc acetate	557346			1,000

Table AP1.T4. List of Hazardous Waste/Substances/Materials
(All notes appear at the end of the table.)

Hazardous Waste/Substance/Material	**CAS No.[1]**	**Threshold Planning Quantity (Pounds)[2]**	**USEPA HW No. [3]**	**RQ (Pounds)[4]**
Zinc ammonium chloride	52628258			1,000
	14639975			
	14639986			
Zinc borate	1332076			1,000
Zinc bromide	7699458			1,000
Zinc carbonate	3486359			1,000
Zinc chloride	7646857			1,000
Zinc cyanide	557211		P121	10
Zinc, dichloro(4,4-dimethyl-5((((methyl-amino)carbonyl)oxy)imino)pentaenitrile)-,(t-4)-	58270089	100/10,000		1
Zinc fluoride	7783495			1,000
Zinc formate	557415			1,000
Zinc hydrosulfite	7779864			1,000
Zinc nitrate	7779886			1,000
Zinc phenosulfonate	127822			5,000
Zinc phosphide	1314847	500	P122	100
Zinc phosphide Zn_3P_2, when present at concentrations greater than 10%	1314847		P122	100
Zinc silicofluoride	16871719			5,000
Zinc sulfate	7733020			1,000
Zirconium nitrate	13746899			5,000
Zirconium potassium fluoride	16923958			1,000
Zirconium sulfate	14644612			5,000
Zirconium tetrachloride	10026116			5,000

F001		**F001**	**10**
The following spent halogenated solvents used in degreasing; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.			
(a) Tetrachloroethylene	127184	U210	100
(b) Trichloroethylene	79016	U228	100
(c) Methylene chloride	75092	U080	1,000
(d) 1,1,1-Trichloroethane	71556	U226	1,000
(e) Carbon tetrachloride	56235	U211	10
(f) Chlorinated fluorocarbons	NA		5,000
F002		**F002**	**10**
The following spent halogenated solvents: all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.			
(a) Tetrachloroethylene	127184	U210	100
(b) Methylene chloride	75092	U080	1,000
(c) Trichloroethylene	79016	U228	100
(d) 1,1,1-Trichloroethane	71556	U226	1,000
(e) Chlorobenzene	108907	U037	100
(f) 1,1,2-Trichloro-1,2,2 trifluoroethane	76131		5,000
(g) o-Dischlorobenzene	95501	U070	100
(h) Trichlorofluoromethane	75694	U121	5,000
(i) 1,1,2-Trichloroethane	79005	U227	100
F003		**F003**	**100**
The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents:			
(a) Xylene	1330207		1,000
(b) Acetone	67641		5,000
(c) Ethyl acetate	141786		5,000
(d) Ethylbenzene	100414		1,000
(e) Ethyl ether	60297		100
(f) Methyl isobutyl ketone	108101		5,000
(g) n-Butyl alcohol	71363		5,000
(h) Cyclohexanone	108941		5,000
(i) Methanol	67561		5,000
F004		**F004**	**100**
The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents:			
(a) Cresols/Cresylic acid	1319773	U052	100
(b) Nitrobenzene	98953	U169	1,000

F005		**F005**	**100**
The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents:			
(a) Toluene	108883	U220	1,000
(b) Methyl ethyl ketone	78933	U159	5,000
(c) Carbon disulfide	75150	P022	100
(d) Isobutanol	78831	U140	5,000
(e) Pyndine	110861	U196	1,000
F006		**F006**	**10**
Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum, (2) tin plating on carbon steel, (3) zinc plating (segregated basis) on carbon steel, (4) aluminum or zinc-aluminum plating on carbon steel, (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel, and (6) chemical etching and milling of aluminum.			
F007		**F007**	**10**
Spent cyanide plating bath solutions from electroplating operations.			
F008		**F008**	**10**
Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.			
F009		**F009**	**10**
Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.			
F010		**F010**	**10**
Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process.			
F011		**F011**	**10**
Spent cyanide solution from salt bath pot cleaning from metal heat treating operations.			
F012		**F012**	**10**
Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process.			
F019		**F019**	**10**
Wastewater treatment sludges from the chemical conversion coating of aluminum except from zirconium phosphating in aluminum can washing when such phosphating is an exclusive coating process.			
F020		**F020**	**1**
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri-or-tetrachlorophenol, or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of hexachlorophene from highly purified 2,4,5-trichlorophenol.)			
F021		**F021**	**1**
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives.			

F022	**F022**	**1**
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions.		
F023	**F023**	**1**
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols. (This listing does not include wastes from equipment used only for the production or use of hexa-chlorophene from highly purified, 2,4,5-tri-chlorophenol.)		
F024	**F024**	**1**
Wastes, including but not limited to distillation residues, heavy ends, tars, and reactor cleanout wastes, from the production of chlorinated aliphatic hydrocarbons, having carbon content from one to five, utilizing free radical catalyzed processes. (This listing does not include light ends, spent filters and filter aids, spent dessicants(sic), wastewater, wastewater treatment sludges, spent catalysts, and wastes listed in Section 261.32.)		
F025	**F025**	**1**
Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution.		
F026	**F026**	**1**
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-penta-, or hexachlorobenzene under alkaline conditions.		
F027	**F027**	**1**
Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing hexachlorophene synthesized from prepurified 2,4,5-tri-chlorophenol as the sole component.)		
F028	**K028**	**1**
Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Numbers F020, F021, F022, F023, F026, and F027.		
F032	**F032**	**1**
Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used clorophenolic formulations (except potentially cross-contaminated wastes that have had the F032 waste code deleted in accordance with 261.35 of this chapter or potentially cross-contaminated wastes that are otherwise currently regulated as hazardous wastes (i.e., F034 or F035), and where the generator does not resume or initiate use of chlorophenolic formulations). This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.		

F034	**F034**	**1**
Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.		
F035	**F035**	**1**
Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.		
F037	**F037**	**1**
Petroleum refinery primary oil/water/solids separation sludge--any sludge generated from the gravitational separation of oil/water/solids during the storage or treatment of process wastewaters and oily cooling wastewaters from petroleum refineries. Such sludges include, but are not limited to, those generated in: oil/water/solids separators; tanks and impoundment; ditches and other conveyances; sumps; and stormwater units receiving dry weather flow. Sludge generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges generated in aggressive biological treatment units as defined in 261.31(b)(2) (including sludges generated in one or more additional units after wastewaters have been treated in aggressive biological treatment unites) and K051 wastes are not included in this listing.		
F038	**F038**	**1**
Petroleum refinery secondary (emulsified) oil/water/solids separation sludge--any sludge and/or float generated from the physical and/or chemical separation of oil/water/solids in process wastewaters from petroleum refineries. Such wastes include, but are not limited to, all sludges and floats generated in: induced air flotation (IAF) units, tanks and impoundments, and all sludges generated in DAF units. Sludges generated in stormwater units that do not receive dry weather flow, sludges generated from once-through non-contact cooling waters segregated from treatment from other process or oil cooling wastes, sludges and floats generated in aggressive biological treatment units as defined in 261.31(b) (2) (including sludges and floats generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and F037, K048, and K051 wastes are not included in this listing.		
K001	**K001**	**1**
Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol.		
K002	**K002**	**10**
Wastewater treatment sludge from the production of chrome yellow and orange pigments.		
K003	**K003**	**10**
Wastewater treatment sludge from the production of molyodate orange pigments.		
K004	**K004**	**10**
Wastewater treatment sludge from the production of zinc yellow pigments.		
K005	**K005**	**10**
Wastewater treatment sludge from the production of chrome green pigments.		
K006	**K006**	**10**
Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated).		

K007 Wastewater treatment sludge from the production of iron blue pigments.	**K007**	**10**
K008 Oven residue from the production of chrome oxide green pigments.	**K008**	**10**
K009 Distillation bottoms from the production of acetaldehyde from ethylene.	**K009**	**10**
K010 Distillation side cuts from the production of acetaldehyde from ethylene.	**K010**	**10**
K011 Bottom stream from the wastewater stripper in the production of acrylonitrile.	**K011**	**10**
K013 Bottom stream from the acetonitrile column in the production of acrylonitrile.	**K013**	**10**
K014 Bottoms from the acetonitrile purification column in the production of acrylonitrile.	**K014**	**5,000**
K015 Still bottoms from the distillation of benzyl chloride.	**K015**	**10**
K016 Heavy ends or distillation residues from the production of carbon tetrachloride.	**K016**	**1**
K017 Heavy ends (still bottoms) from the purification column in the production of epi-chlorohydrin.	**K017**	**10**
K018 Heavy ends from the fractionation column in ethyl chloride production.	**K018**	**1**
K019 Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production.	**K019**	**1**
K020 Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production.	**K020**	**1**
K021 Aqueous spent antimony catalyst waste from fluoromethanes production.	**K021**	**10**
K022 Distillation bottom tars from the production of phenol/acetone from cumene.	**K022**	**1**
K023 Distillation light ends from the production of ophthalic anhydride from naphthalene.	**K023**	**5,000**
K024 Distillation bottoms from the production of phthalic anhydride from naphthalene.	**K024**	**5,000**
K025 Distillation bottoms from the production of nitrobenzene by the nitration of benzene.	**K025**	**10**
K026 Stripping still tails from the production of methyl ethyl pyridines.	**K026**	**1,000**
K027 Centrifuge and distillation residues from toluene diisocyanate production.	**K027**	**10**
K028 Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane.	**K028**	**1**
K029 Waste from the product steam stripper in the production of 1,1,1-trichloroethane.	**K029**	**1**

K030	**K030**	**1**
Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene.		
K031	**K031**	**1**
By-product salts generated in the production of MSMA and cacodylic acid.		
K032	**K032**	**10**
Wastewater treatment sludge from the production of chlordane.		
K033	**K033**	**10**
Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane.		
K034	**K034**	**10**
Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane.		
K035	**K035**	**1**
Wastewater treatment sludges generated in the production of creosote.		
K036	**K036**	**1**
Still bottoms from toluene reclamation distillation in the production of disulfoton.		
K037	**K037**	**1**
Wastewater treatment sludges from the production of disulfoton.		
K038	**K038**	**10**
Wastewater from the washing and stripping of phorate production.		
K039	**K039**	**10**
Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate.		
K040	**K040**	**10**
Wastewater treatment sludge from the production of phorate.		
K041	**K041**	**1**
Wastewater treatment sludge from the production of toxaphene.		
K042	**K042**	**10**
Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T.		
K043	**K043**	**10**
2,6-Dichlorophenol waste from the production of 2,4-D.		
K044	**K044**	**10**
Wastewater treatment sludges from the manufacturing and processing of explosives.		
K045	**K045**	**10**
Spent carbon from the treatment of wastewater containing explosives.		
K046	**K046**	**10**
Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds.		
K047	**K047**	**10**
Pink/red water from TNT operations.		
K048	**K048**	**10**
Dissolved air flotation (DAF) float from the petroleum refining industry.		
K049	**K049**	**10**
Slop oil emulsion solids from the petroleum refining industry.		

K050	**K050**	**10**
Heat exchanger bundle cleaning sludge from the petroleum refining industry.		
K051	**K051**	**10**
API separator sludge from the petroleum refining industry.		
K052	**K052**	**10**
Tank bottoms (leaded) from the petroleum refining industry.		
K060	**K060**	**1**
Ammonia still lime sludge from coking operations.		
K061	**K061**	**10**
Emission control dust/sludge from the primary production of steel in electric furnaces.		
K062	**K062**	**10**
Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry (SIC Codes 331 and 332).		
K064	**K064**	**10**
Acid plant blowdown slurry/sludge resulting from thickening of blowdown slurry from primary copper production.		
K065	**K065**	**10**
Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities.		
K066	**K066**	**10**
Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production.		
K069	**K069**	**10**
Emission control dust/sludge from secondary lead smelting.		
K071	**K071**	**1**
Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used.		
K073	**K073**	**10**
Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production.		
K083	**K083**	**100**
Distillation bottoms from aniline extraction.		
K084	**K084**	**1**
Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.		
K085	**K085**	**10**
Distillation or fractionation column bottoms from the production of chlorobenzenes.		
K086	**K086**	**10**
Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead.		
K087	**K087**	**100**
Decanter tank tar sludge from coking operations.		
K088	**K088**	**10**
Spent potliners from primary aluminum reduction.		

K090	**K090**	**10**
Emission control dust or sludge from ferrochromiumsilicon production.		
K091	**K091**	**10**
Emission control dust or sludge from ferrochromium production.		
K093	**K093**	**5,000**
Distillation light ends from the production of phthalic anhydride from ortho-xylene.		
K094	**K094**	**5,000**
Distillation bottoms from the production of phthalic anhydride from ortho-xylene.		
K095	**K095**	**100**
Distillation bottoms from the production of 1,1,1-trichloroethane.		
K096	**K096**	**100**
Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane.		
K097	**K097**	**1**
Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane.		
K098	**K098**	**1**
Untreated process wastewater from the production of toxaphene.		
K099	**K099**	**10**
Untreated wastewater from the production of 2,4-D.		
K100	**K100**	**10**
Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting.		
K101	**K101**	**1**
Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.		
K102	**K102**	**1**
Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.		
K103	**K103**	**100**
Process residues from aniline extraction from the production of aniline.		
K104	**K104**	**10**
Combined wastewater streams generated from nitrobenzene/aniline production.		
K105	**K105**	**10**
Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes.		
K106	**K106**	**1**
Wastewater treatment sludge from the mercury cell process in chlorine production.		
K107	**K107**	**10**
Column bottoms from product separation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazines.		
K108	**K108**	**10**
Condensed column overheads from product separation and condensed reactor vent gases from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.		
K109	**K109**	**10**
Spent filter cartridges from product purification from the production of 1.1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.		

K110	**K110**	**10**
Condensed column overheads from intermediate separation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.		
K111	**K111**	**10**
Product washwaters from the production of dinitrotoluene via nitration of toluene.		
K112	**K112**	**10**
Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene.		
K113	**K113**	**10**
Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.		
K114	**K114**	**10**
Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.		
K115	**K115**	**10**
Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.		
K116	**K116**	**10**
Organic condensate from the solvent recovery column in the production of toluene disocyanate via phosgenation of toluenediamine.		
K117	**K117**	**1**
Wastewater from the reaction vent gas scrubber in the production of ethylene bromide via bromination of ethene.		
K118	**K118**	**1**
Spent absorbent solids from purification of ethylene dibromide in the production of ethylene dibromide.		
K123	**K123**	**10**
Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salts.		
K124	**K124**	**10**
Reactor vent scrubber water from the production of ethylene- bisdithiocarbamic acid and its salts.		
K125	**K125**	**10**
Filtration, evaporation, and centrifugation solids from the production of ethylenebisdithiocarbamic acid and its salts.		
K126	**K126**	**10**
Baghouse dust and floor sweepings in milling and packaging operations from the production or formulation of ethylene-bisdithiocarbamic acid and its salts.		
K131	**K131**	**100**
Wastewater from the reactor and spent sulfuric acid from the acid dryer in the production of methyl bromide.		
K132	**K132**	**1,000**
Spent absorbent and wastewater solids from the production of methyl bromide.		
K136	**K136**	**1**
Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.		

K141	**K141**	**1**
Process residues from the recovery of coal tar, including but not limited to, tar collecting sump residues from the production of coke or coal or the recovery of coke by-products produced from coal. This listing does not include K087 (decanter tank tar sludge from coking operations).		
K142	**K142**	**1**
Tar storage tank residues from the production of coke or from the recovery of coke by-products produced from coal.		
K143	**K143**	**1**
Process residues from the recovery of light oil, including, but not limited to, those generated in stills, decanters, and wash oil recovery units from the recovery of coke by-products produced from coal.		
K144	**K144**	**1**
Wastewater treatment sludges from light oil refining, including, but not limited to, intercepting or contamination sump sludges from the recovery of coke by-products produced from coal.		
K145	**K145**	**1**
Residues from naphthalene collection and recovery operations from the recovery of coke by-products produced from coal.		
K147	**K147**	**1**
Tar storage tank residues from coal tar refining.		
K148	**K148**	**1**
Residues from coal tar distillation, including, but not limited to, still bottoms.		
K149	**K149**	10
Distillation bottoms from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups. [This waste does not include still bottoms from the distillation of benzyl chloride.]		
K150	**K150**	10
Organic residuals, excluding spent carbon adsorbent, from the spent chlorine gas and hydrochloric acid recovery processes associated with the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups.		
K151	**K151**	10
Wastewater treatment sludges, excluding neutralization and biological sludges, generated during the treatment of wastewaters from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups.		
K157	**K157**	++
Wastewaters (including scrubber waters, condenser waters, washwaters, and separation waters) from the production of carbamates and carbamoyl oximes. (This listing does not include sludges derived from the treatment of these wastewaters.)		
K158	**K158**	++
Bag house dusts and filter/separation solids from the production of carbamates and carbamoyl oximes.		
K159	**K159**	++
Organics from the treatment of thiocarbamate wastes.		
K160	**K160**	++
Solids (including filter wastes, separation solids, and spent catalysts) from the production of thio-carbamates and solids from the treatment of thiocarbamate wastes.		

K161	**K161** ++
Purification solids (including filtration, evaporation, and centrifugation solids), bag house dust, and floor sweepings from the production of dithiocarbamate acids and their salts. (This listing does not include K125 or K126.)	

Notes:
1 Chemical Abstract Service (CAS) Registry Number.
2 USEPA Hazardous Waste Number.
3 Reportable quantity release that requires notification. (See Chapter 18, "Spill Prevention and Response Planning").
4 Includes mono- and di-ethers of ethylene glycol, diethylene glycol, and triethylene glycol R-(OCH2CH2)n-OR'. Where: n = 1, 2, or 3; R = alkyl C7 or less; or R = phenyl or alkyl substituted phenyl; R' = H or alkyl C7 or less; or OR' consisting of carboxylic acid ester, sulfate, phosphate, nitrate, or sulfonate.
++ No reporting of releases of this hazardous substance is required if the diameter of the pieces of the solid metal released is equal to or exceeds 100 micrometers (0.004 inches).
+++ The reportable quantity (RQ) for asbestos is limited to friable forms only.
# Indicates that the RQ is subject to change when the assessment of potential carcinogenicity is completed.
The statutory RQ for this hazardous substance may be adjusted in a future rulemaking; until then the statutory RQ applies.
1* Indicates that the 1-pound RQ is a statutory RQ.
** Indicates that no RQ is being assigned to the generic or broad class.
(1+) Indicates that the statutory source for designation of this hazardous substance under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is Clean Water Act (CWA) Section 311(b)(4).
(2+) Indicates that the statutory source for designation of this hazardous substance under CERCLA is CWA section 30711(a)(4).
(3+) Indicates that the statutory source for designation of this hazardous substance under CERCLA is CAA section 112.
(4+) Indicates that the statutory source for designation of this hazardous substance under CERCLA is Resource Conservation and Recovery Act, Section 3001.

A2. APPENDIX 2

DETERMINATION OF WORST CASE DISCHARGE PLANNING VOLUME

A2.1. This Appendix provides criteria to determine, on an installation-specific basis, the extent of a worst-case discharge (WCD).

A2.2. This Appendix provides criteria to determine the volume of oil or hazardous substance to be used in planning for a WCD. Installations should calculate both WCD volumes that apply to the installation's design and operation and use the larger volume as the WCD planning volume.

A2.3. For installations transferring oil to and from vessels with tank capacities of 10,500 gallons (250 barrels) or more, the WCD planning volume is calculated as follows:

A2.3.1. Where applicable, the loss of the entire capacity of all in-line and break out tank(s) needed for the continuous operation of the pipelines used for the purposes of handling or transporting oil, in bulk, to or from a vessel regardless of the presence of secondary containment; plus

A2.3.2. The discharge from all piping carrying oil between the marine transfer manifold and the valve or manifold adjacent to the POL storage container. The discharge from each pipe is calculated as follows: The maximum time to discover the release from the pipe in hours, plus the maximum time to shut down flow from the pipe in hours (based on historic discharge data or the best estimate in the absence of historic discharge data for the installation) multiplied by the maximum flow rate expressed in gallons per hour (based on the maximum relief valve setting or maximum system pressure when relief valves are not provided) plus the total line drainage volume expressed in gallons for the pipe between the marine transfer manifold and the valve or manifold adjacent to the POL storage container.

AP2.4. For installations with POL Storage Containers:

A2.4.1. Single POL Storage Container Facilities. For facilities containing only one aboveground oil or hazardous substance storage container, the WCD planning volume equals the capacity of the oil or hazardous substance storage container. If adequate secondary containment (sufficiently large to contain the capacity of the above ground oil or hazardous substance storage container plus sufficient freeboard to allow for precipitation) exists for the oil storage container, multiply the capacity of the container by 0.8.

A2.4.2. Multiple POL Storage Container Facilities

A2.4.2.1. Facilities having no secondary containment. If none of the above ground storage containers at the facility have adequate secondary containment, the worst case planning volume equals the total above ground oil and hazardous substance storage capacity at the facility.

A2.4.2.2. Facilities having complete secondary containment. If every above ground storage container at the facility has adequate secondary containment, the WCD planning volume

equals the capacity of the largest single above ground oil or hazardous substance storage container.

A2.4.2.3. Facilities having partial secondary containment. If some, but not all above ground storage containers at the facility have adequate secondary containment, the WCD planning volume equals the sum of:

A2.4.2.3.1. The total capacity of the above ground oil and hazardous substance storage container that lacks adequate secondary containment; plus

A2.4.2.3.2. The capacity of the largest single above ground oil or hazardous substance storage container that has adequate secondary containment.

A2.4.3. For purposes of this Appendix, the term "adequate secondary containment" means an impervious containment system such as a dike, berm, containment curb, drainage system or other device that will prevent the escape of spilled material into the surrounding soil.

SECTION 01 58 00

PROJECT IDENTIFICATION
08/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EP 310-1-6a	(2006) Sign Standards Manual, VOL 1
EP 310-1-6b	(2006) Sign Standards Manual, VOL 2, Appendices

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sign Legend Orders; G M/R

1.3 PROJECT IDENTIFICATION SIGN

1.3.1 Construction Project Signs

Furnish the construction project sign package, maintain the signs during construction, and remove the signs from the job site upon completion of the project. The construction project sign package consists of two signs: one for project identification and the other to show the on-the-job safety performance of the contractor. Ensure that the package conforms to the requirements of EP 310-1-6a and EP 310-1-6b, specifically Section 16. Submit the sign legend orders as described in Section 16 of EP 310-1-6a before erecting the signs.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

PART 1 GENERAL

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 60 percent by weight of total project solid waste shall be diverted from the landfill.

1.2 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. Utilize only those waste disposal or recycling companies that have Corporate Registration (CR) for those activities and have disposal/recycling locations permitted by the Host Nation. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G M/R

SD-06 Test Reports

Monthly Solid Waste Disposal Reports

SD-11 Closeout Submittals

Records

1.4 MEETINGS

After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 00.00 10 QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

a. Pre-bid meeting.

b. Preconstruction Pre-demolition meeting.

c. Regular site QC meetings.

d. Work safety meetings.

1.5 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 30 days before the pre-demolition meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of waste disposal companies to be used including copies of their Corporate Registration (CR) certificates.

g. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

h. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

i. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

j. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

k. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

l. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

m. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.6 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.7 MONTHLY SOLID WASTE DISPOSAL REPORTS

Monthly, submit a solid waste disposal report to the Contracting Officer. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste."

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers,

bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 19.12 10 TEMPORARY ENVIRONMENTAL CONTROLS. Separate materials by one of the following methods:

1.8.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

    (1) Ferrous.

    (2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

    (1) Bond.

    (2) Newsprint.

    (3) Cardboard and paper packaging materials.

i. Plastic.

Type	
1	Polyethylene Terephthalate (PET, PETE)
2	High Density Polyethylene (HDPE)
3	Vinyl (Polyvinyl Chloride or PVC)
4	Low Density Polyethylene (LDPE)
5	Polypropylene (PP)
6	Polystyrene (PS)
7.	Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.8.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.8.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.9.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.9.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1971	(2005; R 2011) Stewardship for the Cleaning of Commercial and Institutional Buildings

GREEN SEAL (GS)

GS-37	(2012) Cleaning Products for Industrial and Institutional Use

MIDDLE EAST DISTRICT (MED)

DIM	Design Instruction Manual

DIM can be located at the below URL:

https://www.tam.usace.army.mil/Business-With-Us/Engineering/Engineering-Files/

U.S. ARMY CORPS OF ENGINEERS (USACE)

ERDC/ITL TR-12-1	(2015) CAD Drafting Standard

U.S. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N	(2014) Navy and Marine Corps Design Procedures
UFC 1-300-08	(2009, with Change 2) Criteria for Transfer and Acceptance of DoD Real Property

U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NFAS 5252.236-9310	Record Drawings

1.2 DEFINITIONS

1.2.1 As-Built Drawings

As-built drawings are developed and maintained by the Contractor and depict actual conditions, including deviations from the Contract Documents. These deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to Contractor submitted Requests for Information; direction from

the Contracting Officer; designs which are the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as red-lined hard copies on site. As-built drawings are further defined in NFAS 5252.236-9310. These files serve as the basis for the creation of the record drawings.

1.2.2 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Warranty Management Plan

Warranty Tags

Final Cleaning

Spare Parts Data

SD-08 Manufacturer's Instructions

Preventative Maintenance

Condition Monitoring (Predictive Testing)

Inspection

Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G R

SD-11 Closeout Submittals

As-Built Drawings; G M/R

Record Drawings; G M/R

As-Built Record of Equipment and Materials; G M/R

Certification of EPA Designated Items; G M/R

Interim DD FORM 1354; G R

1.4 SPARE PARTS DATA

Submit the Spare Parts Data list.

Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

1.5 QUALITY CONTROL

Additions and corrections to the contract drawings must be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols must conform to DIM and be the same as the original line colors, line weights, lettering, layering conventions, and symbols.

1.6 WARRANTY MANAGEMENT

1.6.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of project acceptance and continue for the full product warranty period. A joint 4 month, 9 month and 12 month warranty inspection will be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Include within the warranty management plan , but not limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subContractors, manufacturers or suppliers involved.

b. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

c. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

d. A list for each warranted equipment, item, feature of construction or system indicating:

    (1) Name of item.
    (2) Model and serial numbers.
    (3) Location where installed.
    (4) Name and phone numbers of manufacturers or suppliers.

(5) Names, addresses and telephone numbers of sources of spare parts.
(6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
(7) Cross-reference to warranty certificates as applicable.
(8) Starting point and duration of warranty period.
(9) Summary of maintenance procedures required to continue the warranty in force.
(10) Cross-reference to specific pertinent Operation and Maintenance manuals.
(11) Organization, names and phone numbers of persons to call for warranty service.
(12) Typical response time and repair time expected for various warranted equipment.

e. The plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

f. Procedure and status of tagging of all equipment covered by extended warranties.

g. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.6.2 Performance Bond

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure to respond will be cause for the Contracting Officer to proceed against the Contractor.

d. The performance bond must remain effective throughout the warranty period.

1.6.3 Pre-Warranty Conference

The Pre-Warranty Conference will be conducted at the initial Red Zone meeting to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to

initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, be continuously available, and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.6.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. Include within the report the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframe specified, the Government will perform the work and back charge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Life Safety Systems
(1) Fire suppression systems.
(2) Fire alarm system(s) in place in the building.

Code 1-Air Conditioning Systems
(1) Recreational support.
(2) Air conditioning leak in part of building, if causing damage.
(3) Air conditioning system not cooling properly.

Code 1-Doors
(1) Overhead doors not operational, causing a security, fire, or safety problem.
(2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors
(1) Overhead doors not operational.
(2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical
(1) Power failure (entire area or any building operational after 1600 hours).
(2) Security lights
(3) Smoke detectors

Code 2-Electrical

(1) Power failure (no power to a room or part of building).
(2) Receptacle and lights (in a room or part of building).

Code 3-Electrical
Street lights.

Code 1-Gas
(1) Leaks and breaks.
(2) No gas to family housing unit or cantonment area.

Code 1-Heat
(1) Area power failure affecting heat.
(2) Heater in unit not working.

Code 2-Kitchen Equipment
(1) Dishwasher not operating properly.
(2) All other equipment hampering preparation of a meal.

Code 1-Plumbing
(1) Hot water heater failure.
(2) Leaking water supply pipes.

Code 2-Plumbing
(1) Flush valves not operating properly.
(2) Fixture drain, supply line to commode, or any water pipe leaking.
(3) Commode leaking at base.

Code 3 -Plumbing
Leaky faucets.

Code 3-Interior
(1) Floors damaged.
(2) Paint chipping or peeling.
(3) Casework.

Code 1-Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2-Roof Leaks
Where major damage to property is not occurring, check for location of leak by performing a localized flood test, spray test, or other sufficient means/methods to identify the suspected areas of leaking and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)
No water to facility.

Code 2-Water (Hot)
No hot water in portion of building listed.

Code 3-All other work not listed above.

1.6.5 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two (2) record copies of the warranty tags showing the layout

and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

Type of product/material	
Model number	
Serial number	
Contract number	
Warranty period from/to	
Inspector's signature	
Construction Contractor	
Address	
Telephone number	
Warranty contact	
Address	
Telephone number	
Warranty response time priority code	

PART 2 PRODUCTS

2.1 GOVERNMENT FURNISHED MATERIALS

The Government will provide an optical disc (CD or DVD) at the preconstruction conference that contains the following:

a. One set of "as-designed" electronic CAD files in the specified software and format revised to reflect all amendments and the final contract PDF drawings. The CAD files are provided to enable preparation of as-built or as-constructed drawings. If discrepancies exist between the CAD files and the contract PDF drawings, correct the CAD files to show the contract PDF drawings.

2.1.1 Submittal Registe

Government will enter the submittal register data file in comma separated value (CSV) format into the Resident Management System (RMS) between Contract Award and Notice to Proceed (NTP).

2.2 SYSTEM DESCRIPTION

Prepare the CAD drawing files in AutoCAD Release AutoCAD 2013 or the current format used by the end user compatible with Windows operating system.

2.2.1 Additional Drawings

If additional drawings are required, prepare them using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final record drawings must be identical to that used on the contract drawings.

2.2.1.1 Sheet Numbers and File Names

If a sheet needs to be added between two sequential sheets, append a Supplemental Drawing Designator in accordance with DIM Adding a drawing sheet, and ERDC/ITL TR-12-1 adding or deleting drawing sheets and index sheet procedures.

2.3 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items". Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials:

1) The product does not meet appropriate performance standards;
2) The product is not available within a reasonable time frame;
3) The product is not available competitively (from two or more sources);
4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product).

PART 3 EXECUTION

3.1 AS-BUILT DRAWINGS

Provide and maintain two (2) black line print copies of the PDF contract drawings for as-built Drawings. Submit as-built drawings 30 days prior to contract completion data.

3.1.1 Markup Guidelines

Make comments and markup the drawings complete without reference to letters, memos, or materials that are not part of the As-Built drawing. Show what was changed, how it was changed, where items(s) were relocated and change related details. These working as-built markup prints must be neat, legible and accurate as follows:

a. Use base colors of red, green, and blue. Color code for changes as

follows:

(1) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.

(2) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.

(3) Additions (Green) - Added items, lettering in notes and leaders.

b. Provide a legend if colors other than the "base" colors of red, green, and blue are used.

c. Add and denote any additional equipment or material facilities, service lines, incorporated under As-Built Revisions if not already shown in legend.

d. Use frequent written explanations on markup drawings to describe changes. Do not totally rely on graphic means to convey the revision.

e. Use legible lettering and precise and clear digital values when marking prints. Clarify ambiguities concerning the nature and application of change involved.

f. Wherever a revision is made, also make changes to related section views, details, legend, profiles, plans and elevation views, schedules, notes and call out designations, and mark accordingly to avoid conflicting data on all other sheets.

g. For deletions, cross out all features, data and captions that relate to that revision.

h. For changes on small-scale drawings and in restricted areas, provide large-scale inserts, with leaders to the applicable location.

i. Indicate one of the following when attaching a print or sketch to a markup print:

1) Add an entire drawing to contract drawings

2) Change the contract drawing to show

3) Provided for reference only to further detail the initial design.

j. Incorporate all shop and fabrication drawings into the markup drawings.

3.1.2 As-Built Drawings Content

Revise As-Built Drawings in accordance with DIM. Provide two (2) sets of paper copies from PDF drawings to show the as-built conditions by red-line process during the execution of the project. Keep these working as-built markup drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract drawings which are made during construction or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Submit the working as-built markup drawings for approval prior to submission of each monthly pay estimate. For failure to maintain the working and final record drawings as specified herein, the Contracting Officer will withhold 10

percent of the monthly progress payment until approval of updated drawings. Show on the as-built drawings, but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Layout and schematic drawings of electrical circuits and piping.

d. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

e. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to shop drawings, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

f. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

g. Changes or Revisions which result from the final inspection.

h. Where contract drawings or specifications present options, show only the option selected for construction on the working as-built markup drawings.

i. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

j. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

k. Changes in location of equipment and architectural features.

j. Modifications (include within change order price the cost to change working as-built markup drawings to reflect modifications) and compliance with FC 1-300-09N procedures.

l. Actual location of anchors, construction and control joints, etc., in concrete.

m. Unusual or uncharted obstructions that are encountered in the contract work area during construction.

n. Location, extent, thickness, and size of stone protection particularly where it will be normally submerged by water.

3.2 RECORD DRAWINGS

Prepare and provide Record Drawings in accordance with DIM. Provide two (2) copies of Record Drawings on two separate CDs or DVDs 30 days after project completion.

Prepare final record drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). Transfer the changes from the approved working as-built markup drawings to the original electronic CAD drawing files. Modify the as-built CAD drawing files to correctly show the features of the project as-built by bringing the working CAD drawing set into agreement with approved working as-built markup drawings, and adding such additional drawings as may be necessary. Jointly review the working as-built markup drawings with printouts from working as-built CAD drawing PDF files for accuracy and completeness. Monthly review of working as-built CAD drawing PDF file printouts must cover all sheets revised since the previous review. These PDF drawing files are part of the permanent records of this project. Any drawings damaged or lost must be satisfactorily replaced at no expense to the Government.

a. Drawing revisions (include within change order price the cost to change working and final record drawings to reflect revisions) and compliance with the following procedures.

    (1) Follow directions in the revision for posting descriptive changes.

    (2) The revision delta size must be 8 mm unless the area where the delta is to be placed is crowded. Use a smaller size delta for crowded areas.

    (3) Place a revision delta at the location of each deletion.

    (4) For new details or sections which are added to a drawing, place a revision delta by the detail or section title.

    (5) For minor changes, place a revision delta by the area changed on the drawing (each location).

    (6) For major changes to a drawing, place a revision delta by the title of the affected plan, section, or detail at each location.

    (7) For changes to schedules or drawings, place a revision delta either by the schedule heading or by the change in the schedule.

3.2.1 Final Record Drawing Package

Submit the final record PDF and CAD drawings package for the entire project within 20 days of completion of all phases of work. Submit one set of ANSI D size PDF and CAD files on optical disc, read-only memory (ROM), two sets of ANSI D size prints and one set of the approved working record drawings. The package must be complete in all details and identical in form and function to the contract drawing files supplied by the Government.

3.3 FINAL APPROVED SHOP DRAWINGS

Submit one (1) complete set of final approved project design and shop drawings (electronic and hard copy) seven (7) days transfer of the completed facilities.

3.4 EQUIPMENT

3.4.1 As-Built Record of Equipment and Materials

Furnish one (1) copy of preliminary record of equipment and materials used on the project 60 days prior to final inspection. This preliminary submittal will be reviewed and returned with Government comments. Submit two (2) sets of final record of equipment and materials along with the final O&M manuals at 30 days prior to CCD.

3.4.2 Real Property Equipment

Submit a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the Equipment-In-Place List include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Submit a draft list at time of transfer. Submittfinal list 30 days after transfer of the completed facility.

3.5 OPERATION AND MAINTENANCE MANUALS

Provide project operation and maintenance manuals as specified in Section 01 78 23 OPERATION AND MAINTENANCE MANUALS.

3.6 CLEANUP

Provide final cleaning in accordance with ASTM E1971 and submit two (2) copies of the listing of completed final clean-up items. Leave premises "broom clean." Comply with GS-37 for general purpose cleaning and bathroom cleaning. Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Replace filters of operating equipment. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

3.7 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance, Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements

within the schedule. Provide a signoff blank for the Contractor and Contracting Officer for each test feature; e.g., liter per second, rpm, kilopascal. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

3.8 REAL PROPERTY RECORD

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete and submit an accounting of all installed property with Interim DD FORM 1354. Include any additional assets, improvements, and alterations from the Draft DD FORM 1354. Contact the Contracting Officer for any project specific information necessary to complete the DD FORM 1354. Refer to UFC 1-300-08 for instruction on completing the DD FORM 1354. For information purposes, a blank fillable PDF DD FORM 1354 may be obtained at the following: http://www.dtic.mil/whs/directives/forms/eforms/dd1354.pdf

Submit the completed Checklist for DD FORM 1354 of Installed Building Equipment items. Attach this list to the updated DD FORM 1354.

-- End of Section --

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
08/15

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

O&M Database; G R

Training Plan; G R

Training Outline; G R

Training Content; G R

SD-11 Closeout Submittals

Training Video Recording; G R

Validation of Training Completion; G R

1.2 OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data for the provided equipment, product, or system, defining the importance of system interactions, troubleshooting, and long-term preventive operation and maintenance. Compile, prepare, and aggregate O&M data to include clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.2.2 Package Content

Provide data package content in accordance with paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES. Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Use Data Package 3 for commissioned items without a specified data package requirement in the individual technical sections. Provide a Data Package

3 instead of Data Package 1 or 2, as specified in the individual technical section, for items that are commissioned.

1.2.3 Changes to Submittals

Provide manufacturer-originated changes or revisions to submitted data if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 Commissioning Authority Review and Approval

Submit the commissioned systems and equipment submittals to the Commissioning Authority (CxA) to review for completeness and applicability. Obtain validation from the CxA that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CxA communicates deficiencies to the Contracting Officer. Submit the O&M manuals to the Contracting Officer upon a successful review of the corrections, and with the CxA recommendation for approval and acceptance of these O&M manuals. This work is in addition to the normal review procedures for O&M data.

1.3 O&M DATABASE

Develop an editable, electronic spreadsheet based on the equipment in the Operation and Maintenance Manuals that contains the information required to start a preventive maintenance program. As a minimum, provide list of system equipment, location installed, warranty expiration date, manufacturer, model, and serial number.

1.4 OPERATION AND MAINTENANCE MANUAL FILE FORMAT

Assemble data packages into electronic Operation and Maintenance Manuals. Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains operation, maintenance and record files, project record documents, and training videos. Include a complete electronically linked operation and maintenance directory.

1.4.1 Organization

Bookmark Product and Drawing Information documents using the current version of CSI Masterformat numbering system, and arrange submittals using the specification sections as a structure. Use CSI Masterformat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

1.4.2 CD or DVD Label and Disk Holder or Case

Provide the following information on the disk label and disk holder or case:

a. Building Number

b. Project Title

c. Activity and Location

d. Construction Contract Number

e. Prepared For: (Contracting Agency)

f. Prepared By: (Name, title, phone number and email address)

g. Include the disk content on the disk label

h. Date

i. Virus scanning program used

1.5 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

The following are a detailed description of the data package items listed in paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES.

1.5.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.5.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.5.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.5.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.5.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.5.1.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of utility systems including required valve positions, valve locations and

zones or portions of systems controlled.

1.5.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.5.1.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.5.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.5.1.9 Additional Requirements for HVAC Control Systems

Provide Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of checkout tests and calibrations performed by the Contractor (not Cx tests).

d. Full points list. Provide a listing of rooms with the following information for each room:

(1) Floor

(2) Room number

(3) Room name

(4) Air handler unit ID

(5) Reference drawing number

(6) Air terminal unit tag ID

(7) Heating or cooling valve tag ID

(8) Minimum cfm

(9) Maximum cfm

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Full as-built print out of software program.

g. Marking of system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.5.2 Preventive Maintenance

Provide the following information for preventive and scheduled maintenance to minimize repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.5.2.1 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.5.2.2 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

a. Define the anticipated time required to perform each of each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.5.3 Repair

Provide manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.5.3.1 Troubleshooting Guides and Diagnostic Techniques

Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.5.3.2 Wiring Diagrams and Control Diagrams

Provide point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.5.3.3 Repair Procedures

Provide instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.5.3.4 Removal and Replacement Instructions

Provide step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Use a combination of text and illustrations.

1.5.3.5 Spare Parts and Supply Lists

Provide lists of spare parts and supplies required for repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.5.3.6 Repair Work-Hours

Provide manufacturer's projection of repair work-hours including requirements by type of craft. Identify, and tabulate separately, repair that requires the equipment manufacturer to complete or to participate.

1.5.4 Real Property Equipment

Provide a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Submit the final list 30 days after transfer of the completed facility.

Key the designations to the related area depicted on the contract drawings.

1.5.5 Appendices

Provide information required below and information not specified in the

preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.5.5.1 Product Submittal Data

Provide a copy of SD-03 Product Data submittals documented with the required approval.

1.5.5.2 Manufacturer's Instructions

Provide a copy of SD-08 Manufacturer's Instructions submittals documented with the required approval.

1.5.5.3 O&M Submittal Data

Provide a copy of SD-10 Operation and Maintenance Data submittals documented with the required approval.

1.5.5.4 Parts Identification

Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing must show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Group the parts shown in the listings by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.5.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary componentsof the system. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.5.6 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference the specific operation and maintenance procedures that must be performed to keep the warranty valid. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.5.7 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.5.5.8 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

1.5.5.9 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms. Provide final set points.

1.5.5.10 Field Test Reports

Provide a copy of Field Test Reports (SD-06) submittals documented with the required approval.

1.5.5.11 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Provide the O&M data packages specified in individual technical sections. The information required in each type of data package follows:

1.6.1 Data Package 1

a. Safety precautions and hazards

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Extended warranty information

f. Contractor information

g. Spare parts and supply list

1.6.2 Data Package 2

a. Safety precautions and hazards

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan, schedule, and procedures

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Extended warranty information

m. Contractor information

1.6.3 Data Package 3

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Operating log

h. Lubrication data

i. Preventive maintenance plan, schedule, and procedures

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Product submittal data

q. O&M submittal data

r. Parts identification

s. Warranty information

t. Extended warranty information

u. Testing equipment and special tool information

v. Testing and performance data

w. Contractor information

x. Field test reports

1.6.4 Data Package 4

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Operating log

i. Lubrication data

j. Preventive maintenance plan, schedule, and procedures

k. Cleaning recommendations

l. Troubleshooting guides and diagnostic techniques

m. Wiring diagrams and control diagrams

n. Repair procedures

o. Removal and replacement instructions

p. Spare parts and supply list

q. Repair work-hours

r. Product submittal data

s. O&M submittal data

t. Parts identification

u. Warranty information

v. Extended warranty information

w. Personnel training requirements

x. Testing equipment and special tool information

y. Testing and performance data

z. Contractor information

aa. Field test reports

1.6.5 Data Package 5

a. Safety precautions and hazards

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan, schedule, and procedures

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Extended warranty information

s. Testing and performance data

t. Contractor information

u. Field test reports

v. Additional requirements for HVAC control systems

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TRAINING

Prior to acceptance of the facility by the Contracting Officer for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address aspects of the Operation and Maintenance Manual submitted in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS. eOMSI Manual, as submitted in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Training must include classroom or field lectures based on the system operating requirements. The location of classroom training requires approval by the Contracting Officer.

3.1.1 Training Plan

Submit a written training plan to the Contracting Officer for approval at least 60 calendar days prior to the scheduled training. Training plan must be approved by the Quality Control Manager (QC) prior to forwarding to the Contracting Officer. Also, coordinate the training schedule with the Contracting Officer and QC. Include within the plan the following elements:

a. Equipment included in training

b. Intended audience

c. Location of training

d. Dates of training

e. Objectives

f. Outline of the information to be presented and subjects covered including description

g. Start and finish times and duration of training on each subject

h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)

i. Instructor names and instructor qualifications for each subject

j. List of texts and other materials to be furnished by the Contractor that are required to support training

k. Description of proposed software to be used for video recording of training sessions.

3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The QC is responsible for overseeing and approving the content and adequacy of the training. Provide a brief summary of the FACILITY INFORMATION manual, and a more detailed presentation of the PRODUCT AND DRAWING MANUAL, specified in

Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Spend 95 percent of the instruction time during the presentation on the OPERATION AND MAINTENANCE DATA. Include the following for each system training presentation:

a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.

b. Relevant health and safety issues.

c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.

d. Design intent.

e. Use of O&M Manual Files.

f. Review of control drawings and schematics.

g. Interactions with other systems.

h. Special maintenance and replacement sources.

i. Tenant interaction issues.

3.1.3 Training Outline

Provide the eOMSI Manual files as specified in Section 01 78 24.00 20, FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI), and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.1.4 Training Video Recording

Record classroom training session(s) on video. Provide to the Contracting Officer two copies of the training session(s) in DVD video recording format. Capture within the recording, in video and audio, the instructors' training presentations including question and answer periods with the attendees. The recording camera(s) must be attended by a person during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.1.5 Unresolved Questions from Attendees

If, at the end of the training course, there are questions from attendees that remain unresolved, the instructor must send the answers, in writing, to the Contracting Officer for transmittal to the attendees, and the training video must be modified to include the appropriate clarifications.

3.1.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm Government participation in the training. At the completion of training, submit a signed validation letter that includes a

sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the Contracting Officer, and one copy to the Operation and Maintenance Manual Preparer for inclusion into the Manual's documentation.

3.1.7 Quality Control Coordination

Coordinate this training with the QC in accordance with Section 01 45 00.00 10 QUALITY CONTROL.

-- End of Section --

SECTION 01 78 24.00 20

FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)
02/15

PART 1 GENERAL

1.1 DEFINITIONS AND ABBREVIATIONS

1.1.1 eOMSI Manual

Manual (PDF file) provided by the Contractor that includes, but is not limited to, product information, a facility description with photos, and a list of primary facility systems.

1.1.2 eOMSI Facility Data Workbook (FDW)

A Microsoft Excel spreadsheet containing 17 facility asset fields to be populated with the required information by the Contractor.

1.1.3 Systems

The words "system", "systems", and "equipment", when used in this document refer to as-built systems and equipment.

1.1.4 Computer Assisted Design and Drafting (CADD)

Electronic Computer Assisted Design and Drafting graphic software program that is used to create facility design contract documents and Record Drawings.

1.1.5 KTR

An abbreviation for "Contractor."

1.2 EOMSI MEETINGS

1.2.1 Pre-Construction Conference

Be prepared to discuss the following during this meeting:

a. eOMSI Manual and eOMSI Facility Data Workbook Development Meetings

b. Processes and methods of gathering eOMSI Manual and eOMSI Facility Data Workbook information during construction.

c. The eOMSI Submittals schedule. Include the eOMSI submittal schedule on the Baseline Construction Schedule in accordance with Section 01 32 17.12 10 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS).

d. Electronic eOMSI Facility Data Workbook file for Contractor's use and completion.

1.2.2 eOMSI Manual and Facility Data Workbook Coordination and Mutual Understanding Meeting

Facilitate a meeting after the Post-Award Kickoff Meeting prior to the submission of the eOMSI Progress Submittal. Meeting attendance must

include the Contractor's eOMSI Manual and Facility Data Workbook Preparer, Designer of Record (DOR), and Quality Control Manager, and the Government's Design Manager (DM), Contracting Officer's Representative, and NAVFAC Public Works (PW) Facilities Management Division (FMD). Also include the Mechanical, Electrical, and Fire Protection Sub-Contractors as required.

The purpose of this meeting is to reach a mutual understanding of the scope of work concerning the contract requirements for eOMSI and coordinate the efforts necessary by both the Government and Contractor to ensure an accurate collection, preparation and timely Government review of eOMSI.

1.2.3 Facility Turnover Meeting

Include eOMSI in Red Zone (NRZ) facility turnover meetings as specified in Section 01 30 00, ADMINISTRATIVE REQUIREMENTS.

1.3 SUBMITTAL SCHEDULING

1.3.1 eOMSI, Progress Submittal

Submit the Progress submittal when construction is approximately 50 percent complete, to the Contracting Officer for approval. Provide eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). Include all elements and portions of system construction completed up to this point.

The purpose of this submittal is to verify progress is in accordance with contract requirements as discussed during the eOMSI Coordination and Mutual Understanding Meeting. Field verify a portion of the eOMSI information in accordance with paragraph FIELD VERIFICATION.

1.3.2 eOMSI, Prefinal Submittal

Submit the 100 percent submittal of the eOMSI Prefinal Submittal to the Contracting Officer for approval within 90 calendar days of contractual completion date. This submittal must provide a complete, working document that can be used to operate and maintain the facility. Any portion of the submittal that is incomplete or inaccurate requires the entire submittal to be returned for correction. Any discrepancies discovered during the Government's review of eOMSI Progress submittal must be corrected prior to the Prefinal submission.

The eOMSI Prefinal Submittal must include eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel).

1.3.3 eOMSI, Final Submittal

Submit completed eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). The Final submittal is due at BOD. Any discrepancies discovered during the Government's review of the Prefinal eOMSI submittal, including the Field Verification, must be corrected prior to the Final eOMSI submission.

1.3.4 Final eOMSI Submittal Translation

Provide a translation in Arabic of all items under Facility Information and Primary Systems Information in electronic format. Provide drawings,

charts and tables in both English and the foreign language. If required by Contracting Officer, provide a split format showing the foreign language on the left and English translation on the right.

1.4 UNITS OF MEASURE

Provide eOMSI utilizing the units of measure used in the Government generated contract documents. Metric eOMSI must be in SI (System International) metric units exclusively.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Training Plan; G R

Training Outline; G R

Training Content; G R

SD-11 Closeout Submittals

eOMSI, Progress Submittal; G R

eOMSI, Prefinal Submittal; G R

eOMSI, Final Submittal; G R

Training Video Recording; G R

Validation of Training Completion; G R

PART 2 PRODUCTS

2.1 eOMSI FILES FORMAT

Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains all maintenance and record files, and Project Record Documents and Training Videos. Include a complete electronically linked operation and maintenance directory. Provide four electronic copies of the eOMSI Manuals to the Contracting Officer for approval.

Provide eOMSI Facility Data Workbook on compact disks (CD) or data digital versatile disk (DVD) disks in (EXCEL) format. Scan eOMSI Manual Files and eOMSI Facility Data Workbook for malicious viruses using a commercially available scanning program that is routinely updated to identify and remove current virus threats.

2.1.1 eOMSI Manual Organization

Organize the eOMSI Manuals into two parts: 1) Product and Drawing Information, and 2) Facility Information. Bookmark the PDF files for easy access to the information.

a. Bookmark Facility Information and Primary Systems to at least one level lower than the major system.

b. Bookmark Product and Drawing Information documents using the current version of CSI Masterformat numbering system, and arrange submittals using the specification sections as a structure. Use CSI Masterformat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

2.1.2 eOMSI Manual Compact Disk Label and Disk Holder or Case

Provide the following information on the compact disk label and disk holder or case:

a. Building Number

b. Project Title

c. Activity and Location

d. Construction Contract Number

e. Prepared For: (Contracting Agency)

f. Prepared By: (Name, title, phone number and email address)

g. Include the compact disk content on the disk label

h. Date

i. Virus scanning program used

2.2 EOMSI MANUAL

2.2.1 Product and Drawing Information

Provide an organized record of the facility products, materials, equipment, and minimum information necessary to operate the facility. Provide Product and Drawing Information for all systems in the final constructed facility. Organize and bookmark the information for easy access and quick retrieval.

2.2.1.1 O&M Data

As a minimum, include the O&M Data, submitted in the technical specification sections, and in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.2.1.2 Record Drawings

Provide an electronic, PDF copy of the Record Drawings, prepared in accordance with the MED Design Instructions Manual and Section 01 78 00 CLOSEOUT SUBMITTALS. Bookmark all drawings using the sheet title and

sheet number.

Include Record Drawings as part of the Red-Zone in accordance with Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

2.2.1.3 Utility Record Drawings

Using Record Source Drawings, show and document details of the actual installation of the utility systems; annotate and highlight the eOMSI information. Provide Utility Record Drawings in PDF format. Provide the following drawings at a large enough scale to differentiate designated isolation units from surrounding valves and switches.

a. Utility Schematic Diagrams - Provide a one line schematic diagram for each utility system such as power, water, wastewater, and gas/fuel. Schematic diagram must show from the point where the utility line is connected to the mainline up to the 1.5 meter connection point to the facility. Indicate location or area designation for route of transmission or distribution lines; locations of duct banks, manholes/ handholes or poles; isolation units such as valves and switches; and utility facilities such as pump stations, lift stations, and substations.

b. Enlarged Connection and Cutoff Plans - Provide enlarged floor plans that provide information between the 1.5 meter utility connection point and where utilities connect to facility distribution. Enlarge floor plans / elevations of the rooms where the utility enters the building and indicate on these plans locations of the main interior and exterior connection and cutoff points for all utilities. Also enlarge floor plans / elevations of the rooms where equipment is located. Include enough information to enable someone unfamiliar with the facility to locate the connection and cutoff points. Indicate designations such as room number, panel number, circuit breaker, or valve number, of each utility and equipment connection and cutoff point, and what that connection and cutoff point controls.

2.2.2 Facility Information

Provide the following in Facility Information:

2.2.2.1 General Facility and System Description

Describe the function of the facility. Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code. List and generally describe all the facility systems listed in the Primary Systems Information and any special building features (for example, HVAC Controls, Sprinkler Systems, Cranes, Elevators, and Generators). Include photographs marked up and labeled to show key operating components and the overall facility appearance.

2.2.2.2 Basis of Design

Include the Basis of Design that shows the basic design scope of work, assumptions and the original intentions of the Designer of Record (DOR). Identify the site utility design goals, objectives, design load limits, assumptions, and system features that are critical to the operation and maintenance of the systems.

2.2.2.3 Floor Plans

Provide uncluttered, legible 29.9 by 43.2 cm floor plans. Include room numbers, type or function of spaces, and overall facility dimensions on the floor plans. Do not include items such as construction instructions, references, or frame numbers.

2.2.2.4 Floor Coverings, Wall Surfaces, and Ceiling Surfaces

Provide a table that lists by room number (including hallways and common spaces), the type, and area of finish, manufacturer's product name, identifying number, and color. Include a facility summary of the total area for each type of space and floor, wall, or ceiling finish in the table.

2.2.2.5 Windows

Provide a table that lists by room number (including hallways and common spaces), the type of window, window size, number of each size and type, special features, manufacturer's product name, identifying number, and color. The table must include a facility summary of the total number for each type and size of window.

2.2.2.6 Roofing

Provide the total area of each type of roof surface and system. Provide the name of the roofing product and system; manufacturer's, supplier's, and installer's names, addresses, and phone numbers; manufacturer's product name, identifying number, and color. For each type of roof, provide a recommended inspection, maintenance and repair schedule that details checkpoints, frequencies, and prohibited practices. List roof structural load limits.

2.2.2.7 HVAC Filters

Provide a table that lists the quantity, type, size, and location of each HVAC filter, manufacturer's product name, and identifying number.

2.2.2.8 Lighting Fixtures

Provide a table that lists by room number (including hallways and common spaces), the type of lighting fixture, ballast, number of lighting fixtures, type of lamps and number of lamps, and the manufacturer's product name and the identifying number. The table must include a facility summary of the total number of fixtures of each type and number of lamps of each type.

2.2.2.9 Equipment Listing

Provide a table that lists the major equipment shown on the design equipment schedules. Show the item descriptions, locations, model numbers; and the names, addresses, and telephone numbers of the manufacturers, suppliers, contractors, and subcontractors.

2.2.2.10 System Flow Diagrams

Provide a flow diagram indicating system liquid, air or gas flow during normal operations. Integrate all system components into the diagram. A compilation of non-integrated, flow diagrams for the individual system

components are not acceptable.

2.2.2.11 Valve List

Provide a list of all valves associated with the system. Show valve type, identification number, function, location and normal operating position.

2.2.2.12 Riser Diagrams

Provide riser diagrams and settings of equipment.

2.3 eOMSI FACILITY DATA WORKBOOK

Download the eOMSI Facility Data Workbook at the following location: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf. Complete the KTR Facility Data File tab based on the selection of master systems, systems, and subsystems installed. The following tabs are included in the eOMSI Facility Data File Workbook and serve the purpose stated:

a. Instructions Tab: Instructions for completing Model & Facility Data Matrix Tab and KTR Facility Data File. If a discrepancy exists between what is required in this section and the Workbook, the instructions within the workbook take precedence.

b. Model & Facility Data Matrix Tab: The Matrix lists Required Asset Fields for each SYSTEM and SUBSYSTEM. The Designer of Record selects SYSTEMS and SUBSYSTEMS that are within the project scope, which the Contractor needs to include and populate in KTR Facility Data File tab. The "Required Facility Asset Field Position Numbers," one through seventeen, are pre-populated, and are not editable.

c. Required Asset Fields Tab: Defines the 17 Required Facility Asset Field Position Numbers used in Model and Facility Data Matrix and KTR Facility Data File tabs.

d. KTR Sample Facility Data File Tab: Sample KTR eOMSI facility data file. This spreadsheet shows an example of the mandatory fields of all equipment to be included in the KTR eOMSI Facility Data File, along with their descriptions.

e. KTR Facility Data File Tab: Required eOMSI facility data file deliverable provided to the Government. Provide a separated and unique new row for each facility component or piece of equipment installed. Asset number will be provided at final by the Government.

PART 3 EXECUTION

3.1 FIELD VERIFICATION

Field verify eOMSI Facility Data Workbook information with Contractor and Government personnel. Include the following personnel in this meeting: Contractor's eOMSI Manual and Facility Data Workbook Preparer and Quality Control Manager, and the Government's Contracting Officer's Representative and NAVFAC PW FMD. Request, and provide, an eOMSI Field Verification Meeting no sooner than 14 calendar days after submission of the Progress eOMSI submittal, and another, no sooner than 14 calendar days after submission of the Prefinal eOMSI submittal. During this meeting, the Government and Contractor will verify that the eOMSI Facility Data Workbook is complete and accurate.

Field verify that at least 5 Subsystems under each of the Master Systems are accurate, for a total of 25 Subsystems. For each of these items, verify that the required facility asset field, as defined in the "Model & Facility Data Matrix" tab, contains the specified data and it is accurate (i.e. item description, manufacturer, model no., serial no.). 100 percent accuracy of eOMSI information is required for successful field verification. Any discrepancies discovered must be corrected prior to next eOMSI Facility Data Workbook Submittal.

(1) F10 - Special Construction
(2) G30 - Site Civil/Mechanial Utilities
(3) G40 - Site Electrical Utilities
(4) H10 - Waterfront Structures
(5) H50 - Waterfront Utilities

3.2 eOMSI TRAINING

Prior to acceptance of the facility by the Contracting Officer for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The trainees must include the Facilities Management Specialist, building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address all aspects of the eOMSI Manual and Facility Data Workbook submittal. Training must include classroom and field lectures as applicable. The location of classroom training requires approval by the Contracting Officer.

3.2.1 Training Plan

Submit a written training plan to the Contracting Officer for approval at least 60 calendar days prior to the scheduled training. Indicate prior approval of the training plan by the Quality Control Manager (QC) on the submittal forwarded to the Contracting Officer. Also, coordinate the training schedule with the Contracting Officer and QC. Include within the plan the following elements:

a. Equipment included in training

b. Intended audience

c. Location of training

d. Dates of training

e. Objectives

f. Outline of the information to be presented and subjects covered including description

g. Start and finish times and duration of training on each subject

h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)

i. Instructor names and instructor qualifications for each subject

j. List of texts and other materials required to support training

3.2.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information defined in Section 01 78 23 OPERATIONS AND MAINTENANCE DATA. The QC is responsible for overseeing and approving the content and adequacy of the training. Provide a brief summary of "Facility Information" and a more detailed presentation of, "Primary Systems Information". Spend 95 percent of the instruction time during the presentation on the "Primary Systems Information". Include the following for each Primary system training presentation:

a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.

b. Relevant health and safety issues.

c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.

d. Design intent.

e. Use of O&M Manual Files.

f. Review of control drawings and schematics.

g. Interactions with other systems.

h. Special maintenance and replacement sources.

i. Tenant interaction issues.

3.2.3 Training Outline

Provide the eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.2.4 Training Video Recording

Provide to the Contracting Officer two copies of the training course in DVD video recording format. Capture within the recording, in video and audio, all instructors' training presentations including question and answer periods with the trainees. Confirm proposed software used to create the training is compatible with the using activity resources to play the training materials. The recording camera(s) must be attended by a person during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.2.5 Unresolved Questions from Trainees

If, at the end of the training course, there are questions from trainees that remain unresolved, the instructor must send the answers, in writing, to the Contracting Officer for transmittal to the trainees, and the

training video must be modified to include the appropriate clarifications.

3.2.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm Government participation in the training. At the completion of all training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the Contracting Officer, and one copy to the eOMSI Preparer for inclusion into the eOMSI documentation.

3.2.7 Quality Control Coordination

Coordinate the eOMSI training with the QC in Section 01 45 00.00 10 QUALITY CONTROL.

-- End of Section --

eOMSI Facility Data Workbook (FDW)

Version: ***10-May-15***

TABLE OF CONTENTS

1. General Workbook Overview

1.1 Model & Facility Data Matrix Tab

This tab identifies the **MASTERSYSTEM**, **SYSTEM** and **SUBSYSTEM** based on the project scope. This tab is completed by the **Designer of Record** (DOR) in coordination with **Public Works** (PW) **Facility Management Division** (FMD).

1.2 Required Facility Asset Fields Tab

Provides explanations for each of the **17 Required Facility Asset Fields**.

1.3 KTR Sample Facility Data File Tab

This spreadsheet shows an example of a partially completed **KTR Facility Data File** illustrating the mandatory fields to be completed.

1.4 KTR Facility Data File Tab

This spreadsheet is completed by the **KTR** and submitted to the Government per the project scope and as the facility is constructed.

2. Model & Facility Data Matrix Instructions

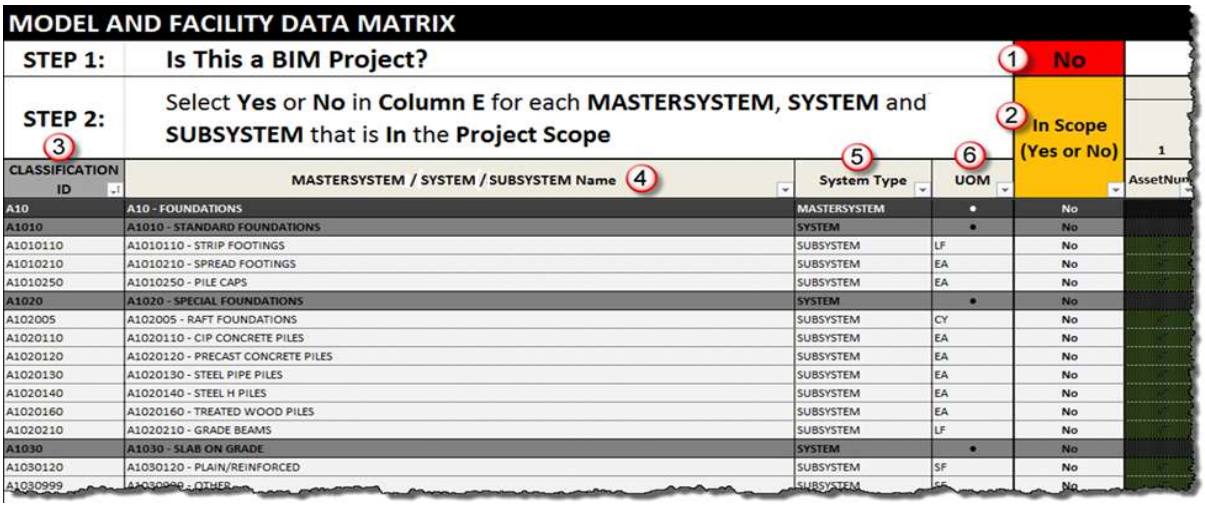
2.1 Model & Facility Data Matrix Tab Overview

The **Model & Facility Data Matrix** tab has two sections:

Section 1 - MASTERSYSTEM, SYSTEM, SUBSYSTEM Name

Section 2 - Required Facility Asset Fields

MASTERSYSTEM, SYSTEM, SUBSYSTEM Name Section



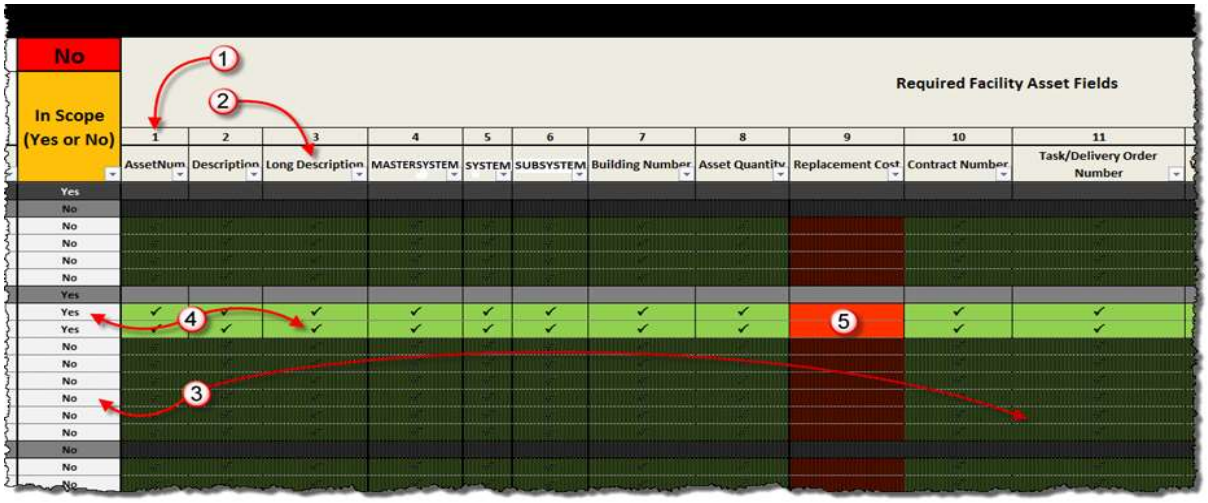
MODEL AND FACILITY DATA MATRIX

STEP 1:	Is This a BIM Project?		① No	
STEP 2:	Select Yes or No in Column E for each MASTERSYSTEM, SYSTEM and SUBSYSTEM that is In the Project Scope		② In Scope (Yes or No)	1
③ CLASSIFICATION ID	④ MASTERSYSTEM / SYSTEM / SUBSYSTEM Name	⑤ System Type	⑥ UOM	AssetNum
A10	A10 - FOUNDATIONS	MASTERSYSTEM	•	No
A1010	A1010 - STANDARD FOUNDATIONS	SYSTEM	•	No
A1010110	A1010110 - STRIP FOOTINGS	SUBSYSTEM	LF	No
A1010210	A1010210 - SPREAD FOOTINGS	SUBSYSTEM	EA	No
A1010250	A1010250 - PILE CAPS	SUBSYSTEM	EA	No
A1020	A1020 - SPECIAL FOUNDATIONS	SYSTEM	•	No
A102005	A102005 - RAFT FOUNDATIONS	SUBSYSTEM	CY	No
A1020110	A1020110 - CIP CONCRETE PILES	SUBSYSTEM	EA	No
A1020120	A1020120 - PRECAST CONCRETE PILES	SUBSYSTEM	EA	No
A1020130	A1020130 - STEEL PIPE PILES	SUBSYSTEM	EA	No
A1020140	A1020140 - STEEL H PILES	SUBSYSTEM	EA	No
A1020160	A1020160 - TREATED WOOD PILES	SUBSYSTEM	EA	No
A1020210	A1020210 - GRADE BEAMS	SUBSYSTEM	LF	No
A1030	A1030 - SLAB ON GRADE	SYSTEM	•	No
A1030120	A1030120 - PLAIN/REINFORCED	SUBSYSTEM	SF	No
A1030999	A1030999 - OTHER	SUBSYSTEM	SF	No

①	Identifies if the project is a BIM project ("**Yes**" or "**No**") For Design-Build (DB) Only Editable: **Yes** Edited By: **DOR**
②	Indicates if the **MASTERSYSTEM**, **SYSTEM** or **SUBSYSTEM** is within the Scope of the project ("**Yes**" or "**No**") Editable: **Yes** Edited By: **DOR**
③	This is the **CLASSIFICATION ID** and is used for organization only Editable: **No**
④	The **MASTERSYSTEM**, **SYSTEM** and **SUBSYSTEM** names that will be used to populate the **MASTERSYSTEM**, **SYSTEM** and **SUBSYSTEM** cells in the **KTR Facility Data File** Editable: **No**
⑤	**System Type** is used for organization only Editable: **No**
⑥	Unit of Measure (**UOM**) Editable: **No**

2.1 Model & Facility Data Matrix Tab Overview (cont.)

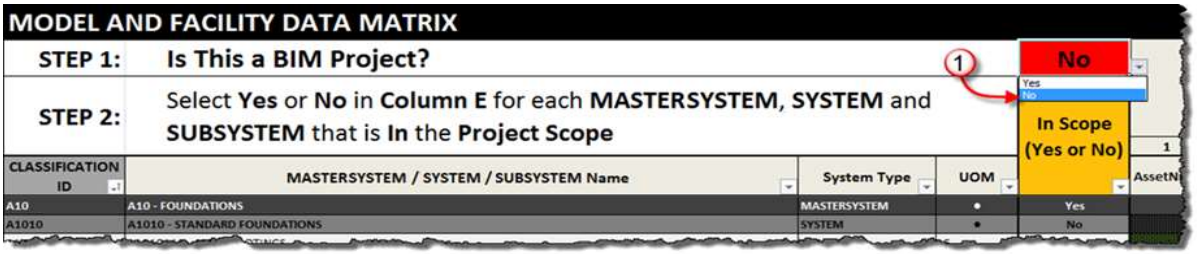
Required Facility Asset Fields Section



1	**Required Facility Asset Field** position number
2	Required **Facility Asset Field** name
3	Grayed out row indicates that the **MASTERSYSTEM**, **SYSTEM** and **SUBSYSTEM** is not in the scope of the project (**In Scope** cell is "**No**"). Setting the **In Scope** cell to "**No**" will automatically gray out the corresponding **Required Facility Asset Fields**.
4	**Green** cell with "✓" indicates that the **SUBSYSTEM** is included in the Project Scope (**In Scope** cell is "**Yes**") and that **Asset Field** is required
5	**Red** cell indicates that the **Asset Field** is not required regardless of **In Scope** cell value ("**Yes**" or "**No**")

2.2 Non-BIM Project Instructions

1. Select "**No**" in the **Is This a BIM Project** cell.

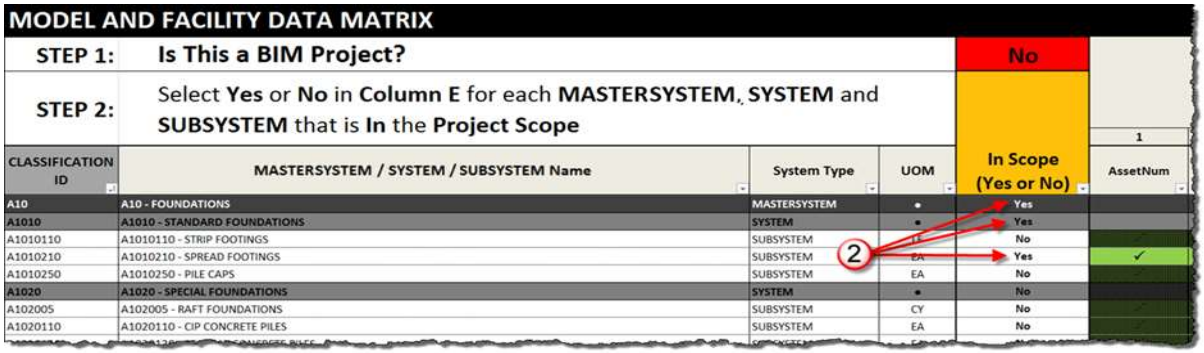


2. For each **MASTERSYSTEM**, **SYSTEM** and **SUBSYSTEM*** that is in the project scope, select "**Yes"** for the **In Scope** cell. When a **SUBSYSTEM*** is set to "**Yes**", the **DOR** shall also set the corresponding **SYSTEM** and **MASTERSYSTEM** cell to "**Yes**".

Critical Note:

SUBSYSTEM*

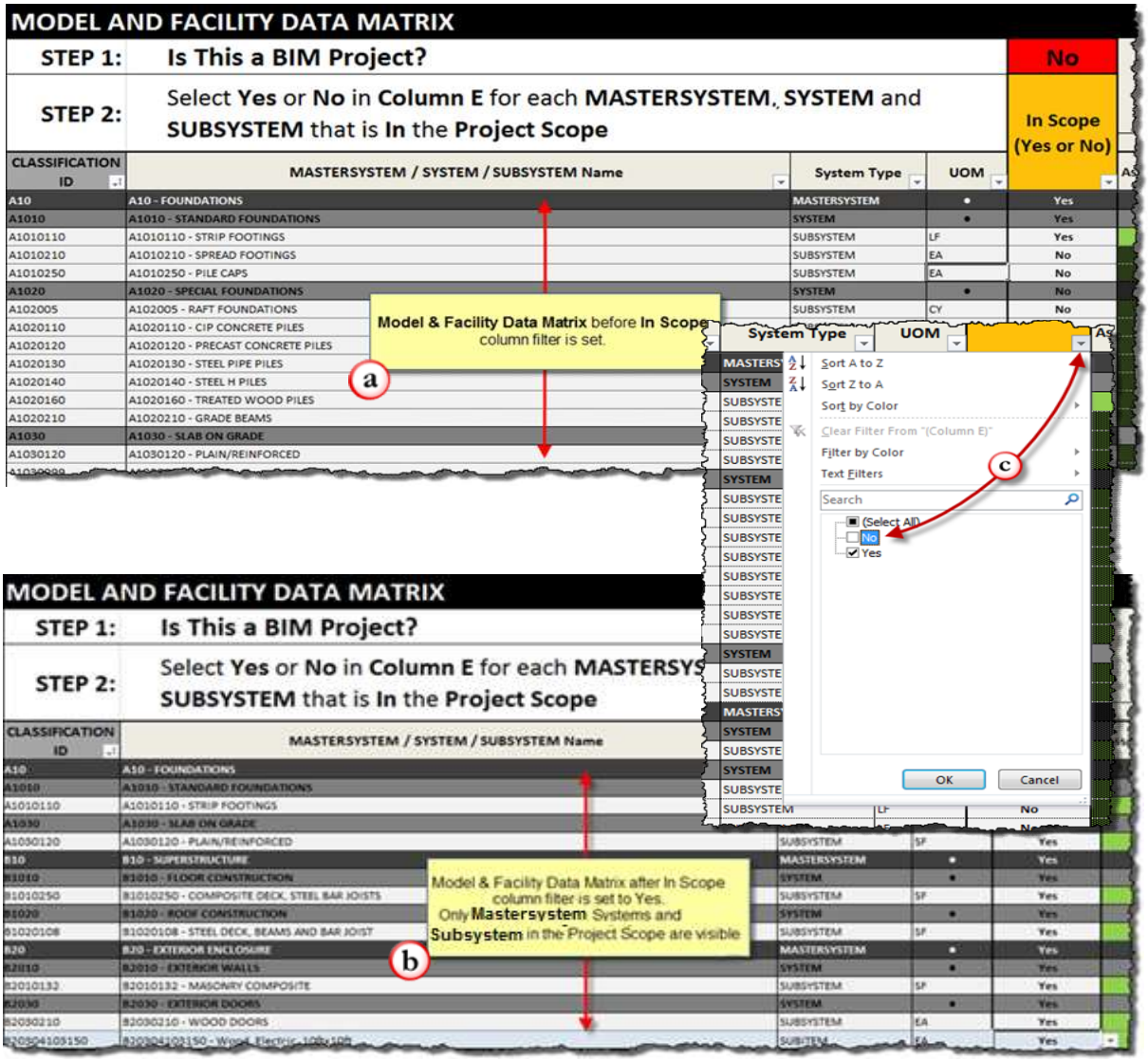
For design elements or features that do not match a specific **SUBSYSTEM** in the **Model & Facility Data Matrix** tab, the **DOR** shall establish a separate "non-match" list for coordination with the project **Public Works** (PW) **Facility Management Division** (FMD) to identify the appropriate **SUBSYSTEM**(s)**.**



2.2 Non-BIM Project Instructions (cont.)

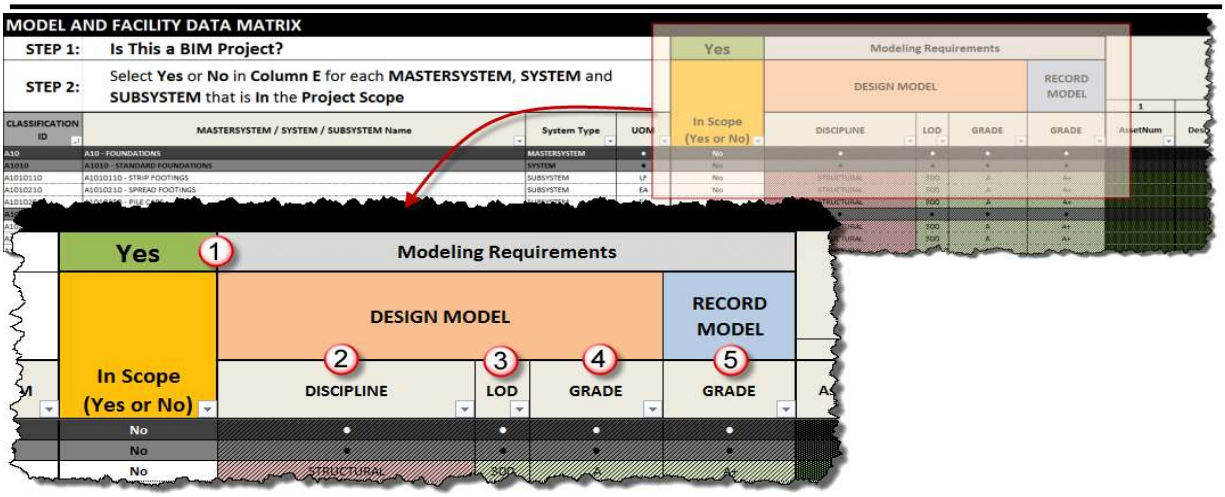
Notes:

a	The **DOR** shall refines the list throughout the Design phase of the project
b	By completion of the Design phase, the **DOR** identifis all **MASTERSYSTEMS, SYSTEMS** and **SUBSYSTEMS** within the scope of the project
c	The **DOR** shall use the **Column Filter** (of the **In Scope** column) to hide all **MASTERSYSTEMS**, **SYSTEMS** and **SUBSYSTEMS** **NOT** within the scope of the project. Select the in-cell drop down of the **In Scope** (**"Yes"** or **"No"**) cell and **UNCHECK** **"No"** from the list (this will hide all rows with **"No"** selected in the cell).



2.3 BIM Project Instructions

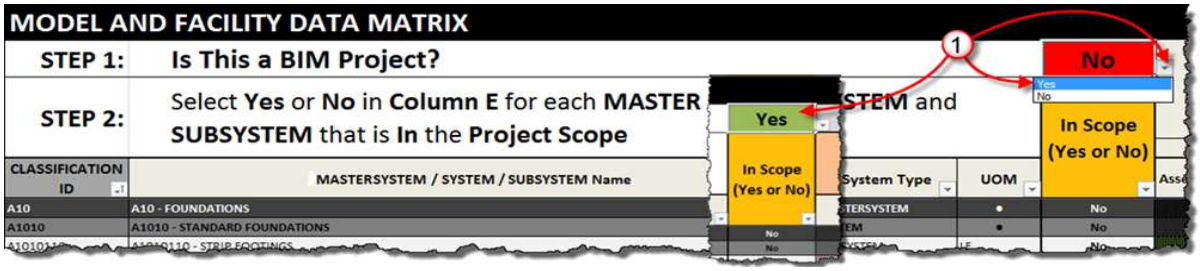
BIM Model Fields Overview



1	Identifies that the **Model and Facility Data Matrix** is a **BIM Project** Editable: **Yes** Edited By: **DOR**
2	Identifies the design discipline responsible for authoring the **SUBSYSTEM** (Model Elements) in the **DESIGN MODEL** Editable: **No** Edited By: **DOR**
3	Defines the **Level of Detail** (**LOD**) for each **SUBSYSTEM** (Model Elements) for the **DESIGN MODEL** Editable: **No** Edited By: **DOR**
4	Defines the **GRADE** for each **SUBSYSTEM** (Model Elements) for the **DESIGN MODEL** Editable: **No** Edited By: **DOR**
5	Defines the **GRADE** for each **SUBSYSTEM** (Model Elements) for the **RECORD MODEL** Editable: **No** Edited By: **DOR**

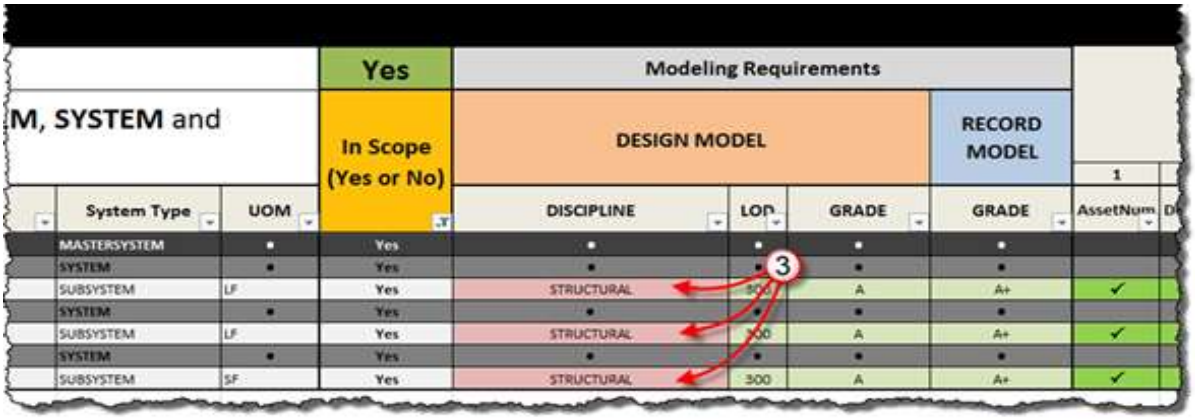
DOR Instructions

1. Select "**Yes**" for **STEP 1** (**Is This a BIM Project**) cell. This will expand the **Modeling Requirements** fields.

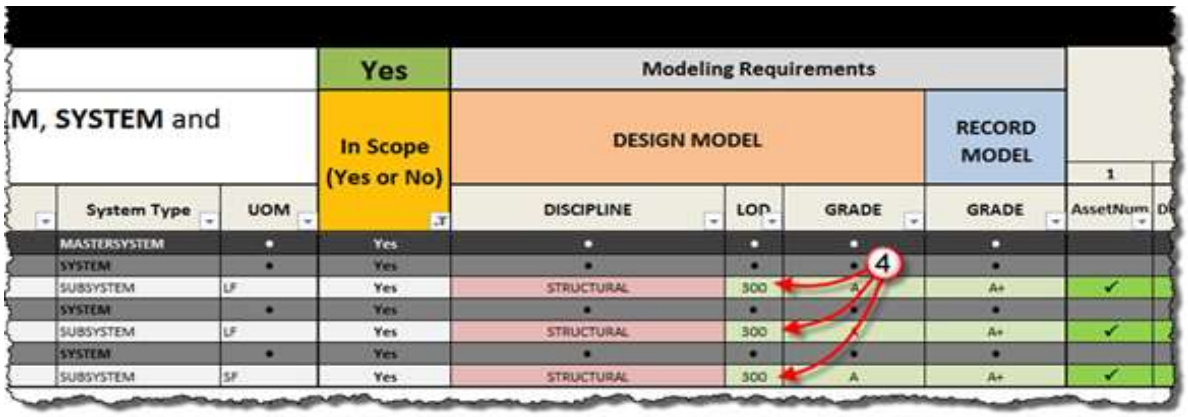


2. Follow instructions for identifying the **MASTERSYSTEM, SYSTEM** and **SUBSYSTEM** defined in **2.2 Non-BIM Project Instructions**.

3. Each **SUBSYSTEM** in the project scope ("**Yes**" in the **In Scope** cell), identifies the **DISCIPLINE** responsible for authoring the **SUBSYSTEM** (Model Elements) in the **DESIGN MODEL**.



4. Each **SUBSYSTEM** in the project scope **("Yes**" in the **In Scope** cell), identifies the **LOD** for each **SUBSYSTEM** (Model Elements) for the **DESIGN MODEL**. Refer to the **Level of Detail (LOD)** chart below for LOD descriptions.

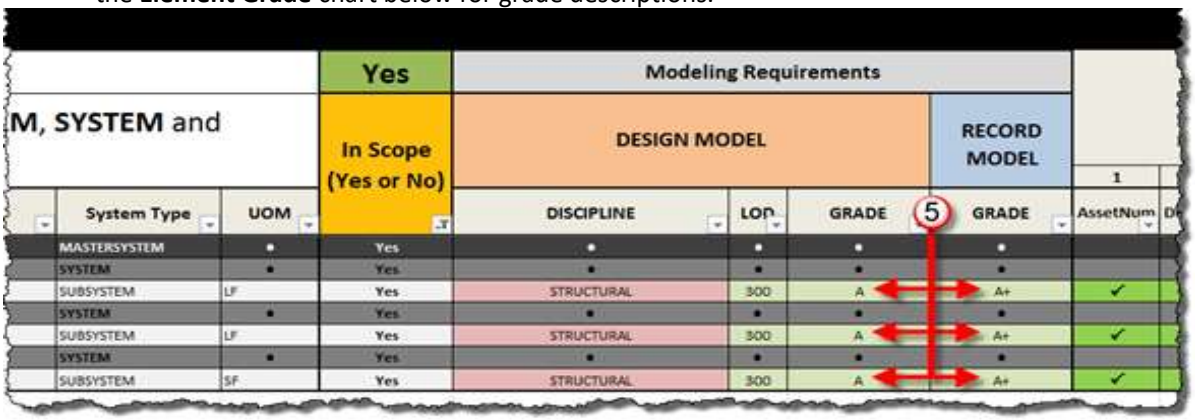


LEVEL OF DETAIL (LOD) - ACCURACY

The following LOD descriptions identify the specific element requirements for each **SUBSYSTEM**.

LOD	DESCRIPTION
•	Not a modeled element but an organizational grouping that is not being modeled. (Used for categories that have multiple sub-elements for which varying LOD apply).
100	Model Elements indicative of area, height, volume, location, and orientation may be modeled geometrically or represented by other data (i.e., a pump would be a cube).
200	Model Elements are modeled as generalized systems or assemblies with approximate quantities, size, shape, location, and orientation. Non-geometric information may also be attached to Model Elements (i.e., a pump would be a generic pump of approximate size).
300	Model Elements are modeled as specific assemblies accurate in terms of quantity, size, shape, location, and orientation. Non-geometric information may also be attached to Model Elements. Accurate to the degree dimensioned or indicated on contract documents (i.e., a pump would be a generic pump of accurate size complete with connections and clearances for a complete system).

5 Each **SUBSYSTEM** in the project scope ("**Yes**" in the **In Scope** cell), identifies the **Grade** for each **SUBSYSTEM** (Model Elements) for the **DESIGN MODEL** and **RECORD MODEL**. Refer to the **Element Grade** chart below for grade descriptions.



M, SYSTEM and		Yes	Modeling Requirements					
		In Scope (Yes or No)	DESIGN MODEL			RECORD MODEL		1
System Type	UOM		DISCIPLINE	LOD	GRADE	5 GRADE	AssetNum	
MASTERSYSTEM	•	Yes	•	•	•	•		
SYSTEM	•	Yes	•	•	•	•		
SUBSYSTEM	LF	Yes	STRUCTURAL	300	A	A+	✓	
SYSTEM	•	Yes	•	•	•	•		
SUBSYSTEM	LF	Yes	STRUCTURAL	300	A	A+	✓	
SYSTEM	•	Yes	•	•	•	•		
SUBSYSTEM	SF	Yes	STRUCTURAL	300	A	A+	✓	

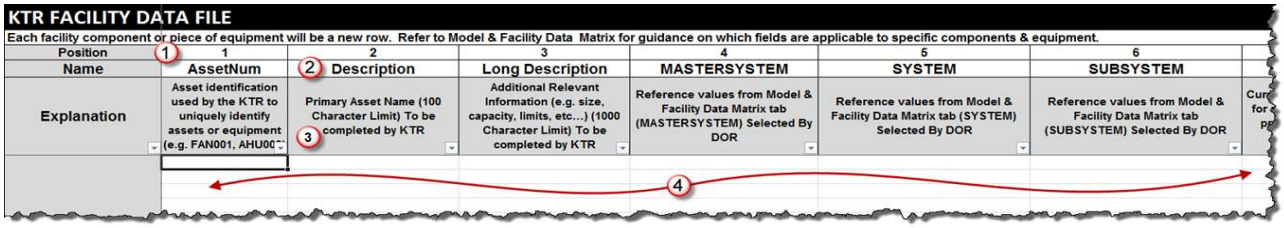
ELEMENT GRADE - FORMAT

Within each LOD, there is the potential to represent information in various **GRADE** formats (2D or 3D).

Grade	Description
A	3D + Required Facility Asset Fields (***applies to design and record model***)
B	2D + Required Facility Asset Fields (***applies to design and record model***)
C	2D Only (Drafting, linework, text, and or part of an assembly) (***applies to design and record model***)
+	Original Grade (A, B, or C) adjusted for contract changes and field conditions. (***applies to record model only***)
-	Not included in or tied to the model (however is still required in the deliverable) (***applies to record model only***)
•	Not a modeled element but an organizational grouping that is not being modeled

3. KTR Facility Data File Instructions

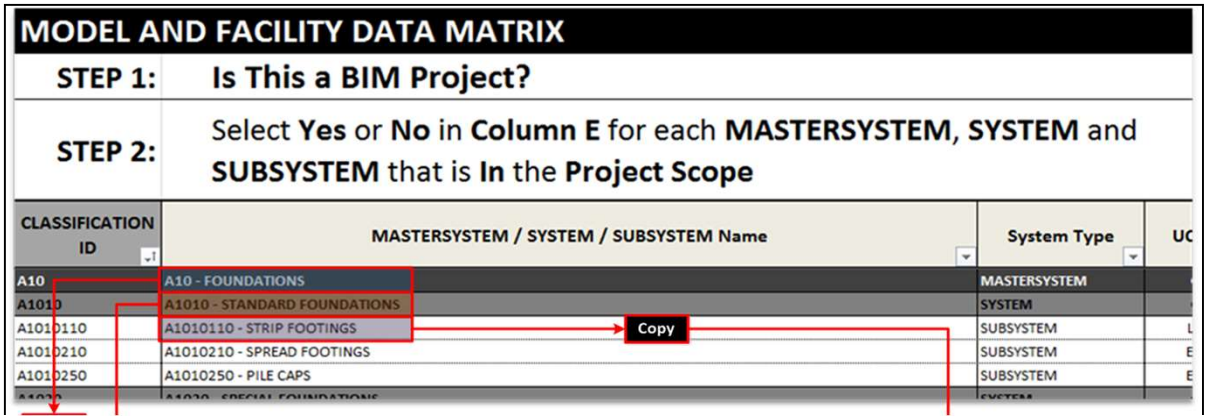
3.1 Facility Data File Overview



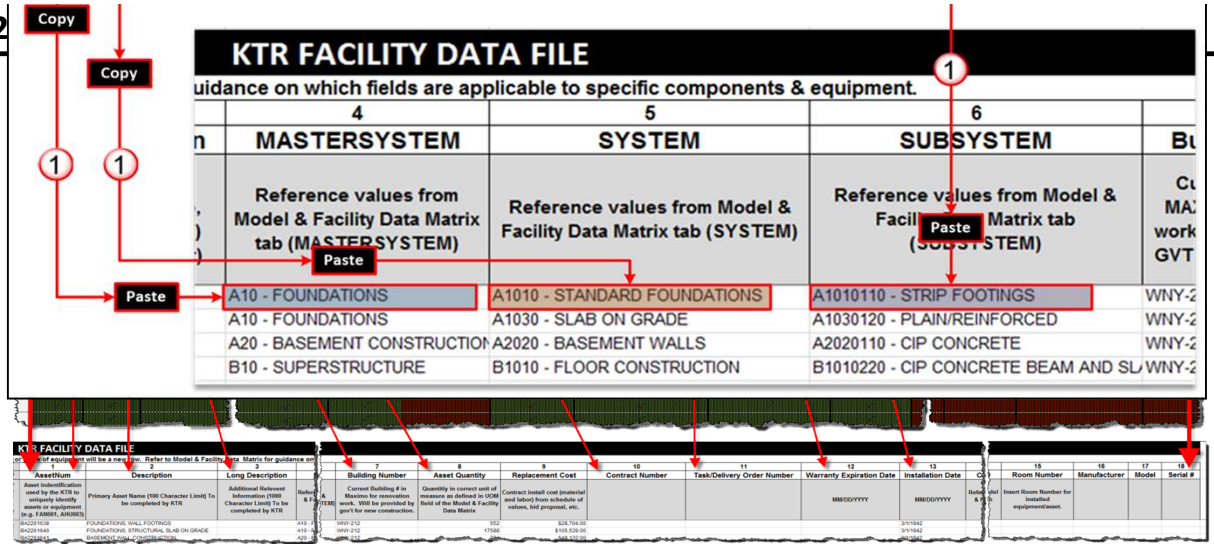
1	Defines the position number of the **Required Facility Asset Fields** Editable: **No**
2	Name of each **Required Facility Asset Field** Editable: **No**
3	Is a brief explanation of the information to be included in the **Required Facility Asset Field** and the party responsible for providing the information Editable: **No**
4	Data populated by the **KTR** for each **SUBSYSTEM** installed in the project. Editable: **Yes** Edited By: **DOR**

3.2 Non-BIM Project Instructions

1. The **KTR** shall "copy and paste" the **MASTERSYSTEM**, **SYSTEM** and **SUBSYSTEM** names from the **Model & Facility Data Matrix** tab (completed by the **DOR**) to the corresponding cells in the **KTR Facility Data File** tab.



3.2



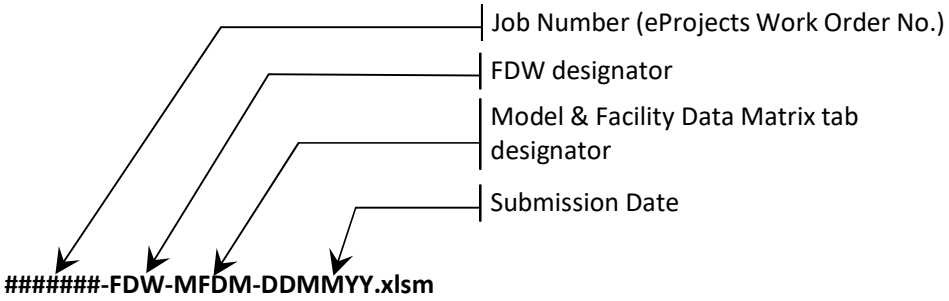
Notes:

(a) Refer to the **KTR Sample Facility Data File** tab.

4. FDW Submittal Naming Convention

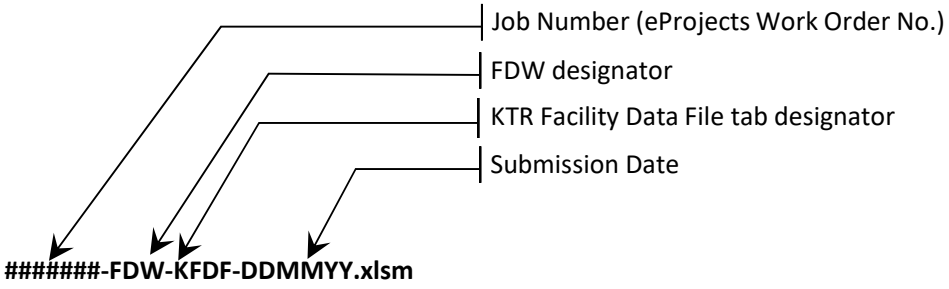
4.1 Model & Facility Data Matrix Tab Submittals

1 For each Model & Facility Data Matrix tab submission by the DOR, use the naming convention shown below:



4.2 KTR Facility Data File Tab Submittals

1 For each KTR Facility Data File tab submission by the KTR, use the naming convention shown below:



MODEL AND FACILITY DATA MATRIX

STEP 1: **Is This a BIM Project?** — **No**

STEP 2: Select **Yes** or **No** in **Column E** for each **MASTERSYSTEM**, **SYSTEM** and **SUBSYSTEM** that is **In** the **Project Scope**

CLASSIFICATION ID	MASTERSYSTEM / SYSTEM / SUBSYSTEM Name	System Type	UOM	In Scope (Yes or No)	Required Facility Asset Fields																
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
					AssetNum	Description	Long Description	MASTERSYSTEM	SYSTEM	SUBSYSTEM	Building Number	Asset Quantity	Replacement Cost	Contract Number	Task/Delivery Order Number	Warranty Expiration Date	Installation Date	Room Number	Manufacturer	Model	Serial #
A10	**A10 - FOUNDATIONS**	**MASTERSYSTEM**	●	Yes																	
A1010		**SYSTEM**	●	Yes																	
A1010110	A1010110 - STRIP FOOTINGS	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1010210	A1010210 - SPREAD FOOTINGS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1010250	A1010250 - PILE CAPS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1020	**A1020 - SPECIAL FOUNDATIONS**	**SYSTEM**	●	Yes																	
A102005	A102005 - RAFT FOUNDATIONS	SUBSYSTEM	CY	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1020110	A1020110 - CIP CONCRETE PILES	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1020120	A1020120 - PRECAST CONCRETE PILES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1020130	A1020130 - STEEL PIPE PILES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1020140	A1020140 - STEEL H PILES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1020160	A1020160 - TREATED WOOD PILES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1020210	A1020210 - GRADE BEAMS	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A1030	**A1030 - SLAB ON GRADE**	**SYSTEM**	●	Yes																	
A1030120	A1030120 - PLAIN/REINFORCED	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A20	**A20 - BASEMENT CONSTRUCTION**	**MASTERSYSTEM**	●	No																	
A2010	**A2010 - BASEMENT EXCAVATION**	**SYSTEM**	●	No																	
A2020	**A2020 - BASEMENT WALLS**	**SYSTEM**	●	No																	
A2020110	A2020110 - CIP CONCRETE	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A2020140	A2020140 - CONCRETE BLOCK	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
A2020150	A2020150 - WOOD	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B10	**B10 - SUPERSTRUCTURE**	**MASTERSYSTEM**	●	Yes																	
B1010	**B1010 - FLOOR CONSTRUCTION**	**SYSTEM**	●	No																	
B1010220	B1010220 - CIP CONCRETE BEAM AND SLAB	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1010238	B1010238 - PRECAST CONCRETE BEAM AND PLANK	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1010244	B1010244 - LIGHT GAUGE STEEL FLOOR SYSTEM	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1010250	B1010250 - COMPOSITE DECK, STEEL BAR JOISTS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1010254	B1010254 - COMP DECK, STRUCTURAL STEEL BEAM	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1010264	B1010264 - WOOD BEAM, JOIST, AND DECK	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1010998	B1010998 - EXTERIOR STAIRS	SUBSYSTEM	FLIGHT	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1020	**B1020 - ROOF CONSTRUCTION**	**SYSTEM**	●	Yes																	
B1020102	B1020102 - WOOD DECK AND RAFTER	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1020108	B1020108 - STEEL DECK, BEAMS AND BAR JOIST	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1020122	B1020122 - CIP CONCRETE ROOF CONSTRUCTION	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1020137	B1020137 - AWNING/CANOPY	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1020901	B1020901 - CIP CONCRETE BEAM AND SLAB	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1020902	B1020902 - PRECAST CONCRETE BEAM AND PLANK	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B1030	**B1030 - ROOF CONSTRUCTION**	**SYSTEM**	●	Yes																	
B103001	B103001 - METAL STRUCTURAL FRAME	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B20	**B20 - EXTERIOR ENCLOSURE**	**MASTERSYSTEM**	●	Yes																	
B2010	**B2010 - EXTERIOR WALLS**	**SYSTEM**	●	Yes																	
B2010101	B2010101 - CIP CONCRETE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010104	B2010104 - PRECAST CONCRETE PANEL (RIBBED)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010106	B2010106 - PRECAST CONCRETE PANEL (TILT UP)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010109	B2010109 - CONCRETE BLOCK	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010125	B2010125 - SOLID BRICK - SINGLE WYTHE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010126	B2010126 - SOLID BRICK - DOUBLE WYTHE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010128	B2010128 - STONE VENEER W/STUD BACKUP	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010130	B2010130 - BRICK VENEER W/STUD BACKUP	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010132	B2010132 - MASONRY COMPOSITE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010134	B2010134 - MASONRY CAVITY	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010140	B2010140 - GLASS BLOCK	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010146	B2010146 - METAL SIDING PANEL	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010148	B2010148 - WOOD CLADDING W/STUD BACKUP	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010151	B2010151 - STUCCO WALL	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2010152	B2010152 - E.I.F.S.	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
B2020	**B2020 - EXTERIOR GLAZED OPENINGS**	**SYSTEM**	●	Yes																	
B2020102	B2020102 - WOOD WINDOWS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2020104	B2020104 - STEEL WINDOWS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2020106	B2020106 - ALUMINUM WINDOWS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2020210	B2020210 - TUBULAR ALUMINUM FRAMING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2020220	B2020220 - CURTAIN WALL PANELS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2030	**B2030 - EXTERIOR DOORS**	**SYSTEM**	●	Yes																	
B2030110	B2030110 - GLAZED DOORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2030210	B2030210 - WOOD DOORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2030220	B2030220 - STEEL DOORS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2030230	B2030230 - ALUMINUM DOORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B2030410	B2030410 - OVERHEAD DOORS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B2030901	B2030901 - HANGAR DOORS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B2030902	B2030902 - BLAST RESISTANT DOORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B30	**B30 - ROOFING**	**MASTERSYSTEM**	●	Yes																	
B3010	**B3010 - ROOF COVERING**	**SYSTEM**	●	Yes																	
B3010105	B3010105 - BUILT-UP	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3010120	B3010120 - SINGLE PLY MEMBRANE	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3010130	B3010130 - PREFORMED METAL	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3010135	B3010135 - FORMED METAL	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3010140	B3010140 - SHINGLE TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3010320	B3010320 - ROOF DECK INSULATION	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3010610	B3010610 - GUTTERS	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3010620	B3010620 - DOWNSPOUTS	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3020	**B3020 - ROOF OPENING**	**SYSTEM**	●	No																	
B3020110	B3020110 - SKYLIGHTS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
B3020210	B3020210 - HATCHES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C10	**C10 - INTERIOR CONSTRUCTION**	**MASTERSYSTEM**	●	Yes																	
C1010	**C1010 - PARTITIONS**	**SYSTEM**	●	Yes																	
C1010102	C1010102 - CONCRETE BLOCK	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
C1010120	C1010120 - TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
C1010126	C1010126 - DRYWALL W/STUD FRAMING	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
C1010140	C1010140 - PLASTER W/STUD FRAMING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
C1010710	C1010710 - INTERIOR WINDOWS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
C1020	**C1020 - INTERIOR DOORS**	**SYSTEM**	●	No																	
C1020102	C1020102 - SPECIAL DOORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1020111	C1020111 - FIRE DOOR, SWINGING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1020112	C1020112 - FIRE DOOR, SLIDING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

C1020113	C1020113 - FIRE DOOR, ROLLING SERVICE/ROLL-UP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1020114	C1020114 - METAL DOOR	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1020120	C1020120 - WOOD DOOR/WOOD FRAME	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1020122	C1020122 - WOOD DOOR/METAL FRAME	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1020124	C1020124 - WOOD FIRE DOORS/METAL FRAMES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1020301	C1020301 - BLAST RESISTANT DOOR	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1030	**C1030 - FITTINGS**	**SYSTEM**	●	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1030110	C1030110 - TOILET PARTITIONS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1030310	C1030310 - LOCKERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1030830	C1030830 - CABINETS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C1030831	C1030831 - COUNTERTOP	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C20	**C20 - STAIRS**	**MASTERSYSTEM**	●	No																	
C2010	**C2010 - STAIR CONSTRUCTION**	**SYSTEM**	●	No																	
C2010110	C2010110 - STAIRS	SUBSYSTEM	FLIGHT	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				
C2020	**C2020 - STAIR FINISHES**	**SYSTEM**	●	No																	
C30	**C30 - INTERIOR FINISHES**	**MASTERSYSTEM**	●	No																	
C3010	**C3010 - WALL FINISHES**	**SYSTEM**	●	No																	
C3010230	C3010230 - WALL COVERING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3010380	C3010380 - WALL TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020	**C3020 - FLOORING**	**SYSTEM**	●	No																	
C3020901	C3020901 - CARPET	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020902	C3020902 - CARPET TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020903	C3020903 - COMPOSITION SHEET	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020904	C3020904 - CONCRETE TOPPING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020905	C3020905 - WOOD	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020906	C3020906 - TERRAZZO	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020907	C3020907 - VINYL TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020908	C3020908 - CORK TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020909	C3020909 - RUBBER SHEET	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020910	C3020910 - PORCELAIN TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020911	C3020911 - QUARRY TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020912	C3020912 - PAINT	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020913	C3020913 - MARBLE TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020914	C3020914 - CERAMIC TILE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3020915	C3020915 - ACCESS FLOORING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3030	**C3030 - CEILING FINISHES**	**SYSTEM**	●	No																	
C3030105	C3030105 - PLASTER	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3030110	C3030110 - DRYWALL	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3030210	C3030210 - ACOUSTICAL	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
C3040	**C3040 - INTERIOR FINISH ASSEMBLIES**	**SYSTEM**	●	No																	
D10	**D10 - CONVEYING**	**MASTERSYSTEM**	●	No																	
D1010	**D1010 - ELEVATORS AND LIFTS**	**SYSTEM**	●	No																	
D1010110	D1010110 - HYDRAULIC ELEVATORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1010140	D1010140 - TRACTION GEARED ELEVATORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1010150	D1010150 - TRACTION GEARLESS ELEVATORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1010160	D1010160 - CABLE DRUM ELEVATOR	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1010200	D1010200 - RACK & PINION AND SCREW COLUMN ELEVATORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1010250	D1010250 - ACCESSIBILITY LIFTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1010300	D1010300 - MATERIAL LIFTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1010901	D1010901 - LIFTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1020	**D1020 - ESCALATORS AND MOVING WALKS**	**SYSTEM**	●	No																	
D1020110	D1020110 - ESCALATORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1020210	D1020210 - MOVING WALKS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1090	**D1090 - OTHER CONVEYING SYSTEMS**	**SYSTEM**	●	No																	
D1090901	D1090901 - CONVEYORS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1090902	D1090902 - CRANES AND HOISTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1090903	D1090903 - PNEUMATIC TUBE SYSTEM	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D20	**D20 - PLUMBING**	**MASTERSYSTEM**	●	No																	
D2010	**D2010 - PLUMBING FIXTURES**	**SYSTEM**	●	No																	
D2010110	D2010110 - TOILET	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010210	D2010210 - URINAL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010310	D2010310 - LAVATORY	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010410	D2010410 - SINK	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010430	D2010430 - LABORATORY SINK	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010510	D2010510 - BATHTUB	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010610	D2010610 - GROUP WASH FOUNTAIN	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010710	D2010710 - SHOWER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010810	D2010810 - DRINKING FOUNTAIN	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010820	D2010820 - WATER COOLER	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010901	D2010901 - EMERGENCY SHOWER	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010902	D2010902 - EMERGENCY EYE WASH	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2010903	D2010903 - BIDET	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020	**D2020 - DOMESTIC WATER DISTRIBUTION**	**SYSTEM**	●	No																	
D2020210	D2020210 - WATER HEATERS, RESIDENTIAL, ELEC	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020220	D2020220 - WATER HEATERS, RESIDENTIAL, GAS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020230	D2020230 - WATER HEATERS, RESIDENTIAL, OIL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020240	D2020240 - WATER HEATERS, COMMERCIAL, ELEC	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020250	D2020250 - WATER HEATERS, COMMERCIAL, GAS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020260	D2020260 - WATER HEATERS, COMMERCIAL, OIL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020901	D2020901 - BOOSTER PUMP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020902	D2020902 - STORAGE TANK	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020903	D2020903 - BACKFLOW PREVENTER	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020904	D2020904 - HEAT TRANSFER PACKAGE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020905	D2020905 - PIPING/FITTINGS	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2020906	D2020906 - CIRCULATING PUMP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2030	**D2030 - SANITARY WASTE**	**SYSTEM**	●	No																	
D2030901	D2030901 - SANITARY WASTE SEPARATOR	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2030902	D2030902 - WASTE/VENT PIPING	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2030905	D2030905 - SUMP PUMP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2040	**D2040 - RAIN WATER DRAINAGE**	**SYSTEM**	●	No																	
D2040210	D2040210 - ROOF DRAINS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D2090	**D2090 - OTHER PLUMBING SYSTEMS**	**SYSTEM**	●	No																	
D30	**D30 - HVAC**	**MASTERSYSTEM**	●	No																	
D3010	**D3010 - ENERGY SUPPLY**	**SYSTEM**	●	No																	
D3020	**D3020 - HEAT GENERATING SYSTEMS**	**SYSTEM**	●	No																	
D3020126	D3020126 - BOILER, ELECTRIC, HOT WATER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020128	D3020128 - BOILER, ELECTRIC, STEAM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

D3020130	D3020130 - BOILER CAST IRON HOT WATER GAS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020134	D3020134 - BOILER, CAST IRON, STEAM, GAS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020136	D3020136 - BOILER, CAST IRON HT WTR GAS/OIL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020138	D3020138 - BOILER, CAST IRON, STEAM GAS/OIL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020311	D3020311 - BOILER FUEL OIL PUMP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020901	D3020901 - BOILER, CAST IRON, HT WTR, OIL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020902	D3020902 - BOILER, CAST IRON, STEAM, OIL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020903	D3020903 - BOILER, SOLID FUEL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020904	D3020904 - BOILER FEEDWATER TANK	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020905	D3020905 - FURNACE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3020906	D3020906 - EXPANSION TANK	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030	**D3030 - COOLING GENERATING SYSTEMS**	**SYSTEM**	•	No																
D3030120	D3030120 - CHILLER, SCROLL, AIR COOLED	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030125	D3030125 - CHILLER, SCROLL, WATER COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030130	D3030130 - CHILLER, RECIP, WATER COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030135	D3030135 - CHILLER, RECIP, AIR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030140	D3030140 - CHILLER, CENTRIFUGAL, WTR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030145	D3030145 - CHILLER, GAS ABSO, WTR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030150	D3030150 - CHILLER, STEAM ABSO, WTR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030160	D3030160 - CHILLER, SCREW, AIR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030165	D3030165 - CHILLER, SCREW, WATER COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030221	D3030221 - CONDENSING UNIT, AIR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030222	D3030222 - CONDENSING UNIT, WATER COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030223	D3030223 - SPLIT DUCTLESS HEAT PUMP , OUTDOOR UNIT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030223	D3030223 - SPLIT DUCTLESS UNIT, OUTDOOR UNIT	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030224	D3030224 - SPLIT SYSTEM HEAT PUMP , OUTDOOR UNIT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030225	D3030225 - SPLIT DUCTLESS HEAT PUMP , OUTDOOR UNIT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030310	D3030310 - COOLING TOWER, GALVANIZED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030320	D3030320 - COOLING TOWER, FIBERGLASS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030330	D3030330 - COOLING TOWER, STAINLESS STEEL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030901	D3030901 - CONDENSER, DX, AIR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030902	D3030902 - CONDENSER, DX, EVAPORATIVE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3030903	D3030903 - PACKAGED DX REFRIGERANT SYSTEM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040	**D3040 - DISTRIBUTION SYSTEMS**	**SYSTEM**	•	No																
D3040106	D3040106 - AIR HANDLING UNIT, FIELD FAB	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040110	D3040110 - AIR HANDLING UNIT, CENTRAL STA	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040114	D3040114 - AIR HANDLING UNIT, ROOFTOP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040118	D3040118 - FAN COIL A/C, CAB MNT, TWO PIPE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040122	D3040122 - FAN COIL A/C, CAB MNT, FOUR PIPE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040124	D3040124 - FAN COIL A/C, DUCT MOUNT, 2 PIPE	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040128	D3040128 - FAN COIL A/C, DUCT MOUNT, 4 PIPE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040132	D3040132 - VAV TERMINAL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040136	D3040136 - VAV TERMINAL, FAN POWERED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040220	D3040220 - FAN SYSTEM, CENTRIFUGAL IN-LINE	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040230	D3040230 - FAN SYSTEM, UTILITY SET	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040240	D3040240 - FAN SYSTEM, ROOF EXHAUST	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040250	D3040250 - COMM/IND VACUUM DUST COLLECTION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040260	D3040260 - KITCHEN EXHAUST/MAKE-UP AIR	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040312	D3040312 - CONDENSATE RETURN PUMP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040313	D3040313 - CONDENSATE RETURN PUMP, DUPLEX	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040330	D3040330 - CIRCULATING PUMP, END SUCTION	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040340	D3040340 - CIRCULATING PUMP, DOUBLE SUCTION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040610	D3040610 - HEAT EXCHANGER, PLATE TYPE	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040620	D3040620 - HEAT EXCHANGER, SHELL TUBE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040901	D3040901 - DEHUMIDIFIER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040902	D3040902 - HUMIDIFIER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040903	D3040903 - FAN COIL A/C, DX	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040904	D3040904 - SPLIT DUCTLESS SYSTEM, INDOOR UNIT	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3040905	D3040905 - SPLIT SYSTEM HEAT PUMP, INDOOR UNIT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050	**D3050 - TERMINAL & PACKAGE UNITS**	**SYSTEM**	•	No																
D3050120	D3050120 - UNIT HEATERS, GAS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050130	D3050130 - UNIT HEATERS, HYDRONIC	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050170	D3050170 - SPLIT SYSTEMS AIR COOLED CONDENSE UNIT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050175	D3050175 - ROOFTOP A/C	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050176	D3050176 - ROOFTOP AIR CONDITIONER, ELECTRIC HEAT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050178	D3050178 - ROOFTOP AIR CONDITIONER, HOT WATER HEAT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050179	D3050179 - ROOFTOP AIR CONDITIONER, STEAM HEAT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050185	D3050185 - COMPUTER ROOM COOLING UNITS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050201	D3050201 - PKG A/C, AIR COOLED, ELEC HEAT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050203	D3050203 - PKG A/C, AIR COOLED, HW HEAT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050210	D3050210 - PKG A/C, WATER COOLED, ELEC HEAT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050220	D3050220 - PKG A/C, WATER COOLED, HW HEAT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050230	D3050230 - HEAT PUMP, WTR SOURCE, CENT STA	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050235	D3050235 - HEAT PUMP, WATER SOURCE, CONSOLE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050240	D3050240 - HEAT PUMP, DUCT MNT, HORIZONTAL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050245	D3050245 - HEAT PUMP, AIR/AIR, ROOF TOP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050255	D3050255 - THRU-WALL A/C UNIT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050260	D3050260 - THRU-WALL HEAT PUMP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050330	D3050330 - PACKAGE TERMINAL AIR CONDITIONER (PTAC)	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050340	D3050340 - PACKAGE TERMINAL HEAT PUMP (PTHP)	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050530	D3050530 - BASEBOARD HEATING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050901	D3050901 - UNIT HEATERS, ELECTRIC	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050902	D3050902 - UNIT HEATER, INFRARED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050904	D3050904 - SMOKE VENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3050905	D3050905 - HYDRONIC HEATING - FIN TUBE	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3060	**D3060 - CONTROLS & INSTRUMENTATION**	**SYSTEM**	•	No																
D3060901	D3060901 - HVAC CONTROLS, ELECTRIC, DIGITAL	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3060902	D3060902 - HVAC CONTROLS, PNUEMATIC	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3060903	D3060903 - AIR COMPRESSOR	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3060904	D3060904 - AIR DRYER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3060905	D3060905 - DIRECT DIGITAL CONTROL (DDC) SYSTEM	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3090	**D3090 - OTHER HVAC SYSTEMS & EQUIPMENT**	**SYSTEM**	•	No																
D3090220	D3090220 - ENERGY RECOVERY WHEEL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3090310	D3090310 - FUME HOOD EXHAUST SYSTEM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3090320	D3090320 - GARAGE EXHAUST SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3090901	D3090901 - INDUSTRIAL EXHAUST SYSTEM	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3090902	D3090902 - CHEMICAL FEEDWATER	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3090903	D3090903 - AIR CURTAIN	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D40	**D40 - FIRE PROTECTION**	**MASTERSYSTEM**	•	No																
D4010	**D4010 - SPRINKLERS**	**SYSTEM**	•	No																
D4010310	D4010310 - DRY PIPE SYSTEMS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4010350	D4010350 - PREACTION SYSTEMS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4010370	D4010370 - DELUGE SYSTEMS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4010390	D4010390 - FIRECYCLE SYSTEMS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4010410	D4010410 - WET PIPE SYSTEMS	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

D4010905	D4010905 - FIRE PUMP, ELECTRIC MOTOR DRIVEN	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4010906	D4010906 - FIRE PUMP, ENGINE DRIVIEN	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4010907	D4010907 - JOCKEY PUMP	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4010908	D4010908 - AIR COMPRESSOR	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4020	**D4020 - STANDPIPES**	**SYSTEM**	•	No																	
D4020310	D4020310 - RISER	SUBSYSTEM	FLOOR	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4030	**D4030 - FIRE PROTECTION SPECIALTIES**	**SYSTEM**	•	No																	
D4090	**D4090 - OTHER FIRE PROTECTION SYSTEMS**	**SYSTEM**	•	No																	
D4090901	D4090901 - CARBON DIOXIDE EXTINGUISHING SYS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4090902	D4090902 - HOOD FIRE PROTECTION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4090903	D4090903 - BACKFLOW PREVENTER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4090904	D4090904 - FIRE PUMPS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4090920	D4090920 - CLEAN AGENT EXTINGUISHING SYSTEM	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D50	**D50 - ELECTRICAL**	**MASTERSYSTEM**	•	Yes																	
D5010	**D5010 - ELECTRICAL SERVICE & DISTRIBUTION**	**SYSTEM**	•	Yes																	
D5010120	D5010120 - ELECTRICAL SERVICE	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5010240	D5010240 - SWITCHGEAR	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5010901	D5010901 - TRANSFER SWITCH	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5010902	D5010902 - TRANSFORMER	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5010903	D5010903 - MOTOR CONTROL CENTER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5010905	D5010905 - CAPACITOR BANK	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5010906	D5010906 - PANELBOARDS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5020	**D5020 - LIGHTING & BRANCH WIRING**	**SYSTEM**	•	Yes																	
D5020120	D5020120 - ELECTRICAL DISTRIBUTION	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5020248	D5020248 - INTERIOR LIGHTING, FLUORECENT	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5020250	D5020250 - INTERIOR LIGHTING, INCANDESCENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5020252	D5020252 - INTERIOR LIGHTING, HIGH INT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5020901	D5020901 - EXIT LIGHTING	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5020902	D5020902 - EXPLOSION PROOF LIGHTING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5020903	D5020903 - EXTERIOR LIGHTING	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5030	**D5030 - COMMUNICATION AND SECURITY**	**SYSTEM**	•	No																	
D5030910	D5030910 - COMMUNICATION/ALARM SYSTEMS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5030911	D5030911 - FIRE ALARM CONTROL PANEL & ALARM SYSTEM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5030930	D5030930 - MASTER BOX	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D5090	**D5090 - OTHER ELECTRICAL SYSTEMS**	**SYSTEM**	•	Yes																	
D5090210	D5090210 - GENERATORS	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5090901	D5090901 - EMERGENCY LIGHTING	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5090902	D5090902 - LIGHTNING PROTECTION (ARRESTERS)	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5090903	D5090903 - GROUNDING SYSTEM	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
D5090904	D5090904 - UNINTERUPTIBLE POWER SUPPLY	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
E10	**E10 - EQUIPMENT**	**MASTERSYSTEM**	•	No																	
E1010	**E1010 - COMMERCIAL EQUIPMENT**	**SYSTEM**	•	No																	
E1010220	E1010220 - CONDENSING UNIT, AIR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E1010901	E1010901 - CONDENSER, DX, AIR COOLED	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E1010910	E1010910 - REFRIGERATOR/FREEZER WALK-IN BOX	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E1020	**E1020 - INSTITUTIONAL EQUIPMENT**	**SYSTEM**	•	No																	
E1030	**E1030 - VEHICULAR EQUIPMENT**	**SYSTEM**	•	No																	
E1030110	E1030110 - VEHICULAR SERVICE EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E1030111	E1030111 - AIR COMPRESSOR	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E1030112	E1030112 - AIR DRYER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E1030310	E1030310 - LOADING DOCK EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E1040	**E1040 - INDUSTRIAL PROCESS EQUIPMENT**	**SYSTEM**	•	No																	
E1090	**E1090 - OTHER EQUIPMENT**	**SYSTEM**	•	No																	
E20	**E20 - FURNISHINGS**	**MASTERSYSTEM**	•	No																	
E2010	**E2010 - FIXED FURNISHINGS**	**SYSTEM**	•	No																	
E2020	**E2020 - MOVEABLE FURNISHINGS**	**SYSTEM**	•	No																	
E202002	E202002 - MODULAR PREFABRICATED FURNITURE	SUBSYSTEM	EA	No																	
F10	**F10 - SPECIAL CONSTRUCTION**	**MASTERSYSTEM**	•	Yes																	
F1010	**F1010 - SPECIAL STRUCTURES**	**SYSTEM**	•	Yes																	
F101001	F101001 - PRE-ENGINEERED STRUCTURES	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F101001.01	F101001.01 - K-SPAN BUILT STRUCTURES	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F101003	F101003 - AIR SUPPORTED STRUCTURES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F101099.01	F101099.01 - PAINT BOOTH	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F101099.02	F101099.02 - PORTABLE OFFICE UNITS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F1020	**F1020 - INTEGRATED CONSTRUCTION**	**SYSTEM**	•	No																	
F102001	F102001 - SPECIAL PURPOSE ROOMS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F102002	F102002 - INTEGRATED ASSEMBLIES	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F1030	**F1030 - SPECIAL CONSTRUCTION SYSTEMS**	**SYSTEM**	•	No																	
F103001	F103001 - VAULTS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F103002	F103002 - SOUND VIBRATION AND SEISMIC CONSTRUCTION	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F103003	F103003 - RADIATION PROTECTION	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F1040	**F1040 - SPECIAL FACILITIES**	**SYSTEM**	•	No																	
F104001	F104001 - INTERIOR SWIMMING POOLS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F104002	F104002 - LIQUID AND GAS STORAGE TANKS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F104003	F104003 - KENNELS AND ANIMAL SHELTERS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F104004	F104004 - SITE CONSTRUCTED INCINERATORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F104005	F104005 - ICE RINKS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F1050	**F1050 - SPECIAL CONTROLS AND INSTRUMENTATION**	**SYSTEM**	•	No																	
F105001	F105001 - RECORDING INSTRUMENTATION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F105002	F105002 - BUILDING AUTOMATION SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
F20	**F20 - SELECTIVE BUILDING DEMOLITION**	**MASTERSYSTEM**	•	Yes																	
F2010	**F2010 - BUILDING ELEMENTS DEMOLITION**	**SYSTEM**	•	Yes																	
F201001	F201001 - SUBSTRUCTURE AND SUPERSTRUCTURE	SUBSYSTEM	LS	No																	
F201002	F201002 - EXTERIOR ENCLOSURE	SUBSYSTEM	LS	Yes																	
F201003	F201003 - ROOFING	SUBSYSTEM	LS	Yes																	
F201004	F201004 - INTERIOR CONSTRUCTION AND FINISHES	SUBSYSTEM	LS	No																	
F201005	F201005 - CONVEYING SYSTEMS	SUBSYSTEM	LS	No																	
F201006	F201006 - MECHANICAL SYSTEMS	SUBSYSTEM	LS	No																	
F201007	F201007 - ELECTRICAL SYSTEMS	SUBSYSTEM	LS	No																	
F201008	F201008 - EQUIPMENT AND FURNISHINGS	SUBSYSTEM	LS	No																	
F2020	**F2020 - HAZARDOUS COMPONENTS & SUPERSTRUCTURE**	**SYSTEM**	•	No																	

F202001	F202001 - SUBSTRUCTURE AND SUPERSTUCUTRE	SUBSYSTEM	LS	No																	
F202002	F202002 - EXTERIOR ENCLOSURE	SUBSYSTEM	LS	No																	
F202003	F202003 - ROOFING	SUBSYSTEM	LS	No																	
F202004	F202004 - INTERIOR CONSTRUCTION AND FINISHES	SUBSYSTEM	LS	No																	
F202005	F202005 - CONVEYING SYSTEMS	SUBSYSTEM	LS	No																	
F202006	F202006 - MECHANICAL SYSTEMS	SUBSYSTEM	LS	No																	
F202007	F202007 - ELECTRICAL SYSTEMS	SUBSYSTEM	LS	No																	
F202008	F202008 - EQUIPMENT AND FURNISHINGS	SUBSYSTEM	LS	No																	
F30	**F30 - BUILDING SERVICES**	**MASTERSYSTEM**	•	No																	
F3010	**F3010 - JANITORIAL SERVICES**	**SYSTEM**	•	No																	
F301010	F301010 - JANITORIAL SERVICES	SUBSYSTEM	SF	No																	
G20	**G20 - SITE IMPROVEMENTS**	**MASTERSYSTEM**	•	No																	
G2010	**G2010 - PAVEMENTS**	**SYSTEM**	•	No																	
G201002.01	G201002.01 - CURBS AND GUTTERS	SUBSYSTEM	CY	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201002.02	G201002.02 - DRAINS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201003.01	G201003.01 - FLEXIBLE ASPHALT PAVEMENTS	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201003.02	G201003.02 - RIGID CONCRETE PAVEMENTS	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201004	G201004 - MARKINGS AND SIGNAGE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201005	G201005 - GUARDRAILS AND BARRIERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201005.01	G201005.01 - VEHICLE CRASH BARRIER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201005.02	G201005.02 - VEHICLE CRASH BEAM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201005.03	G201005.03 - VEHICLE RETRACTABLE BOLLARDS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201005.04	G201005.04 - VEHICLE TRAFFIC ARM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201005.05	G201005.05 - VEHICLE TRAFFIC SPIKES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201099.01	G201099.01 - COMPOSITE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201099.02	G201099.02 - PAVERS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G201099.03	G201099.03 - UNIMPROVED/GRAVEL	SUBSYSTEM	CY	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2020	**G2020 - A PARKING LOT /PARKING AREA PAVEMENT**	**SYSTEM**	•	No																	
G202001	G202001 - PARKING LOT BASES AND SUBBASES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G202005.01	G202005.01 - GUARD RAIL AND POSTS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G202005.02	G202005.02 - WHEEL STOPS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2020061	G2020061 - ASHPALT RESURFACING	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2020062	G2020062 - CONCRETE RESURFACING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G202007	G202007 - PARKING METERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2030	**G2030 - PEDESTRIAN PAVING**	**SYSTEM**	•	No																	
G203003.01	G203003.01 - ASPHALT PEDESTRIAN PAVING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G203003.02	G203003.02 - CONCRETE PEDESTRIAN PAVING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G203003.03	G203003.03 - PAVERS PEDESTRIAN PAVING	SUBSYSTEM	SF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2040	**G2040 - SITE IMPROVEMENTS & AMMENITIES**	**SYSTEM**	•	No																	
G204001.01	G204001.01 - FENCES AND GATES	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204001.02	G204001.02 - FENCES - CHAIN LINK	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204001.03	G204001.03 - FENCES - MISCELLANEOUS METAL	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204002	G204002 - RETAINING WALLS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204005	G204005 - SIGNAGE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204006.01	G204006.01 - FOUNTAINS, POOLS AND WATERCOURSES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204006.02	G204006.02 - FOUNTAINS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204008.01	G204008.01 - TERRACE AND PERIMETER WALLS	SUBSYSTEM	CY	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204008.02	G204008.02 - STONE WALL	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204008.03	G204008.03 - FREE STANDING BRICK WALL	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204009	G204009 - FLAG POLES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099	G204099 - TRUCK SCALES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.01	G204099.01 - SITE FURNISHINGS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.02	G204099.02 - SITE SEATING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.03	G204099.03 - HANDRAIL - PIPE RAILINGS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.04	G204099.04 - CIGARETTE RECEPTACLE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.05	G204099.05 - GUARD RAILS AND POSTS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.06	G204099.06 - TRASH CANS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.07	G204099.07 - MAILBOXES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.08	G204099.08 - TURNSTILES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G204099.09	G204099.09 - OUTDOOR COVERING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2050	**G2050 - LANDSCAPING**	**SYSTEM**	•	No																	
G205004	G205004 - LAWNS AND GRASSES	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G205005	G205005 - EXTERIOR PLANTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G205006	G205006 - PLANTERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G205007.01	G205007.01 - IRRIGATION PIPING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G205007.02	G205007.02 - IRRIGATION BACKFLOW PREVENTION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G205007.03	G205007.03 - IRRIGATION CONTROLS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G205099	G205099 - LANDSCAPING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2060	**G2060 - A ROAD/ STREET PAVEMENT**	**SYSTEM**	•	No																	
G206001	G206001 - ROAD BASES AND SUBBASES	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G2099	**G2099 - OTHER SITE IMPROVEMENTS**	**SYSTEM**	•	No																	
G90	**G90 - OTHER SITE CONSTRUCTION**	**MASTERSYSTEM**	•	No																	
G9010	**G9010 - SERVICE AND PEDESTRIAN TUNNELS**	**SYSTEM**	•	No																	
G901001.01	G901001.01 - SERVICE TUNNELS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G901001.04	G901001.04 - INITIAL TUNNEL SUPPORT SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G901001.05	G901001.05 - BORING OR JACKING CONDUITS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G901001.06	G901001.06 - MICROTUNNELING	SUBSYSTEM	LF	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G901001.07	G901001.07 - TRENCH BOXES	SUBSYSTEM	CY	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G901001.08	G901001.08 - PEDESTRIAN TUNNELS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G9090	**G9090 - OTHER SITE SYSTEMS & EQUIPMENT**	**SYSTEM**	•	No																	
G909001.01	G909001.01 - VEHICULAR BRIDGES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G909001.02	G909001.02 - PREFABRICATED BRIDGES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G909002	G909002 - RAILROAD TRACKS AND BEDS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G909002.01	G909002.01 - RAILROAD TRACK	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G909002.02	G909002.02 - RAILROAD GRADE CROSSINGS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G909002.03	G909002.03 - RAILROAD TRAIN SCALES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
G909003	G909003 - SNOW MELTING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H10	**H10 - WATERFRONT STRUCTURES**	**MASTERSYSTEM**	•	No																	
H1010	**H1010 - SUBSTRUCTURE**	**SYSTEM**	•	No																	
H101004	H101004 - RELIEVING PLATFORMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H1020	**H1020 - SUPERSTRUCTURE**	**SYSTEM**	•	No																	
H1030	**H1030 - DECK COMPONENTS**	**SYSTEM**	•	No																	
H103009	H103009 - GUARD POSTS AND RAILINGS	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H103010	H103010 - PAINT STRIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H1040	**H1040 - FENDER SYSTEMS**	**SYSTEM**	•	No																	
H104003	H104003 - CORNER FENDER SYSTEM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H1050	**H1050 - MOORING HARDWARE**	**SYSTEM**	•	No																	
H1060	**H1060 - APPURTENANCES**	**SYSTEM**	•	No																	
H1099	**H1099 - OTHER WATERFRONT STRUCTURES**	**SYSTEM**	•	No																	
H20	**H20 - GRAVING DRYDOCKS**	**MASTERSYSTEM**	•	No																	
H2010	**H2010 - DOCK BASIC STRUCTURE**	**SYSTEM**	•	No																	
H201001	H201001 - DOCK BASIC STRUCTURE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H201002	H201002 - DOCK FITTINGS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H201003	H201003 - DOCK MECHANICAL EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H201004	H201004 - DOCK SERVICES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

H201005	H201005 - FIRE PROTECTION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H2020	**H2020 - PUMP HOUSE**	**SYSTEM**	●	No																	
H202001	H202001 - PUMP HOUSE BASIC STRUCTURES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H202002	H202002 - PUMP HOUSE ELECTRIC EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H202003	H202003 - PUMP HOUSE MISC. SYSTEMS/EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H2030	**H2030 - CAISSON**	**SYSTEM**	●	No																	
H203001	H203001 - CAISSON EXTERIOR STRUCTURE	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H203002	H203002 - CAISSON INTERIOR STRUCTURE - MACHINERY DECK	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H203003	H203003 - CAISSON INTERIOR STRUCTURE - BALLAST & TRIM TANKS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H203004	H203004 - CAISSON MECHANICAL EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H203005	H203005 - CAISSON ELECTRICAL EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H203006	H203006 - MISC. CAISSON SYSTEMS/EQUIPMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H30	**H30 - COASTAL PROTECTION**	**MASTERSYSTEM**	●	No																	
H3010	**H3010 - WAVE PROTECTION**	**SYSTEM**	●	No																	
H301001	H301001 - WAVE PROTECTION ARMORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H301002	H301002 - BREAKWATERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H3020	**H3020 - SLOPE PROTECTION**	**SYSTEM**	●	No																	
H30200	H302003- COMBINED FILL REVETMENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H302001	H302001 - ROCK REVETMENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H302002	H302002 - GRANULAR FILL REVETMENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
H40	**H40 - NAVIGATION DREDGING AND RECLAMATION**	**MASTERSYSTEM**	●	No																	
H4010	**H4010 - DREDGING**	**SYSTEM**	●	No																	
H401010	H401010 - DREDGING COMPONENTS	SUBSYSTEM	EA	No																	
H4020	**H4020 - DREDGING DISPOSAL**	**SYSTEM**	●	No																	
H402001	H402001 - OCEAN DISPOSAL	SUBSYSTEM	EA	No																	
H402002	H402002 - NEW CONFINED DISPOSAL FACILITIES	SUBSYSTEM	EA	No																	
H402003	H402003 - EXISTING CONFINED DISPOSAL FACILITIES	SUBSYSTEM	EA	No																	
H4030	**H4030 - RECLAMATION**	**SYSTEM**	●	No																	
H403001	H403001 - RECLAMATION COMPONENTS	SUBSYSTEM	EA	No																	
H60	**H60 - WATERFRONT DEMOLITION**	**MASTERSYSTEM**	●	No																	
H6010	**H6010 - IN-WATER OR OVER-WATER DEMOLITION**	**SYSTEM**	●	No																	
H601001	H601001 - COMPLETE WATERFRONT DEMOLITION	SUBSYSTEM	EA	No																	
H601002	H601002 - DEMOLITION OF COMPONENTS	SUBSYSTEM	EA	No																	
H601003	H601003 - RELOCATION OF WATERFRONT UTILITIES	SUBSYSTEM	EA	No																	
H6020	**H6020 - NON IN-WATER OR OVER-WATER DEMOLITION**	**SYSTEM**	●	No																	
H602001	H602001 - COMPLETE WATERFRONT DEMOLITION	SUBSYSTEM	EA	No																	
H602002	H602002 - DEMOLITION OF COMPONENTS	SUBSYSTEM	EA	Yes																	
H602003	H602003 - RELOCATION OF WATERFRONT AND UTILITIES	SUBSYSTEM	EA	Yes																	
H6030	**H6030 - HAZARDOUS COMPONENTS**	**SYSTEM**	●	No																	
H603001	H603001 - REMOVAL OF HAZARDOUS COMPONENTS	SUBSYSTEM	EA	No																	
H603002	H603002 - ENCAPSULATION OF HAZARDOUS COMPONENTS	SUBSYSTEM	EA	No																	
H70	**H70 - WATERFRONT ANTI-TERRORIST FORCE PROTECTION**	**MASTERSYSTEM**	●	No																	
H7010	**H7010 - WATERSIDE ANTITERRORISM/FORCE PROTECTION**	**SYSTEM**	●	No																	
H701001	H701001 - WATERSIDE AT/FP COMPONENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
H7020	**H7020 - LANDSIDE ANTITERRORISM/FORCE PROTECTION**	**SYSTEM**	●	No																	
H702001	H702001 - LANDSIDE AT/FP COMPONENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I10	**I10 - AIRFIELD SITE IMPROVEMENTS**	**MASTERSYSTEM**	●	No																	
I1010	**I1010 - AIRFIELD PAVEMENTS**	**SYSTEM**	●	No																	
I101004	I101004 - RUNWAY OVERRUN SURFACE CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101005	I101005 - RUNWAY SHOULDER SURFACE ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101006	I101006 - RUNWAY SHOULDER SURFACE CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101007	I101007 - RUNWAY BASES AND SUBBASES (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101008	I101008 - RUNWAY MARKING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101009	I101009 - RUNWAY RESURFACING ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101010	I101010 - RUNWAY RESURFACING CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101011	I101011 - RUNWAY SURFACE ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101012	I101012 - RUNWAY SURFACE CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I101013	I101013 - RUNWAY OVERRUNS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I1020	**I1020 - AIRFIELD PAVEMENT-TAXIWAY (BRANCH)**	**SYSTEM**	●	No																	
I102001	I102001 - TAXIWAY SURFACE ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I102002	I102002 - TAXIWAY SURFACE CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I102003	I102003 - TAXIWAY SHOULDER SURFACE ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I102004	I102004 - TAXIWAY SHOULDER SURFACE CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I102005	I102005 - TAXIWAY BASES AND SUBBASES (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I102006	I102006 - TAXIWAY MARKING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I102007	I102007 - TAXIWAY RESURFACING ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I102008	I102008 - TAXIWAYRESURFACING CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I1030	**I1030 - AIRFIELD PAVEMENT-PARKING APRON (BRANCH)**	**SYSTEM**	●	No																	
I103001	I103001 - PARKING APRON SURFACE ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I103002	I103002 - PARKING APRON CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I103003	I103003 - PARKING APRON BASES AND SUBBASES (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I103004	I103004 - PARKING APRON MARKING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I103005	I103005 - PARKING APRON RESURFACING ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I103006	I103006 - PARKING APRON RESURFACING CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
I1040	**I1040 - AIRFIELD PAVEMENT- PAD & OTHER MISCELLANEOUS AIRFIELD PAVEMENTS (BRANCH)**	**SYSTEM**	●	No																	
I1050	**I1050 - AIRFIELD PAVEMENT-HELIPAD (BRANCH)**	**SYSTEM**	●	No																	
I105001	I105001 - HELIPAD SURFACE ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
I105002	I105002 - HELIPAD CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
I105003	I105003 - HELIPAD BASES AND SUBBASES (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
I105004	I105004 - HELIPAD MARKING	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
I105005	I105005 - HELIPAD RESURFACING ASPHALT (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
I105006	I105006 - HELIPAD RESURFACING CONCRETE (SECTION)	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
I20	**I20 - AIRFIELD ELECTRICAL UTILITIES**	**MASTERSYSTEM**	●	No																	
I2010	**I2010 - AIRFIELD LIGHTING**	**SYSTEM**	●	No																	
I201001	I201001 - AIRFIELD LIGHTING COMPONENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I2020	**I2020 - AIRFIELD LIGHTING VAULTS**	**SYSTEM**	●	No																	
I202001	I202001 - AIRFIELD LIGHTING VAULT COMPONENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I2099	**I2099 - OTHER AIRFIELD SITE IMPROVEMENTS**	**SYSTEM**	●	No																	
I30	**I30 - AIRFIELD SPECIAL CONSTRUCTION**	**MASTERSYSTEM**	●	No																	
I3010	**I3010 - AIRFIELD SPECIALTY SYSTEMS**	**SYSTEM**	●	No																	
I301001	I301001 - AIRFIELD SPECIALTY SYSTEM COMPONENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
I40	**I40 - AIRCRAFT ENGINE TEST CELLS**	**MASTERSYSTEM**	●	No																	
I4010	**I4010 - PRIMARY INTAKE**	**SYSTEM**	●	No																	
I40100	**I40100 - FIRE SYSTEM**	**SYSTEM**	●	No																	
I40110	**I40110 - DYNAMOMETER**	**SYSTEM**	●	No																	
I40120	**I40120 - TIE-DOWNS**	**SYSTEM**	●	No																	
I40130	**I40130 - CONTROL ROOM**	**SYSTEM**	●	No																	
I40140	**I40140 - JET BLAST DEFLECTOR**	**SYSTEM**	●	No																	
I4020	**I4020 - SECONDARY INTAKE**	**SYSTEM**	●	No																	
I4030	**I4030 - EXHAUST STACK**	**SYSTEM**	●	No																	
I4040	**I4040 - AUGMENTER**	**SYSTEM**	●	No																	
I4050	**I4050 - RUN ROOM**	**SYSTEM**	●	No																	
I4060	**I4060 - FLOOR**	**SYSTEM**	●	No																	
I4070	**I4070 - DOORS AND WINDOWS**	**SYSTEM**	●	No																	

I4080	**I4080 - FUEL SYSTEM/PRESERVATION OIL**	**SYSTEM**	**•**	**No**															
I4090	**I4090 - START SYSTEM**	**SYSTEM**	**•**	**No**															
I4090100	I4090100 - AIR START	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I4090110	I4090110 - HYDRAULIC START	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I4090120	I4090120 - ELECTRIC START	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I40999	**I40999 - OTHER AIRCRAFT ENGINE TEST CELLS**	**SYSTEM**	**•**	**No**															
J10	**J10 - Electric Utilities**	**MASTERSYSTEM**	**•**	**No**															
J1010	**J1010 - Production**	**SYSTEM**	**•**	**No**															
J1010110	J1010110 - UG Structures	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010120	J1010120 - Support Structures	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010130	J1010130 - Switch Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010140	J1010140 - Sub Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010150	J1010150 - Circuits	SUBSYSTEM	LF	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010155	J1010155 - Plant Electrical	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010160	J1010160 - Power Generation	SUBSYSTEM	KW	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010170	J1010170 - Plant Controls	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010175	J1010175 - Cooling System	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010180	J1010180 - Fuel System	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010185	J1010185 - Compressed Air	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1010190	J1010190 - Power Conversion	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1020	**J1020 - Transmission**	**SYSTEM**	**•**	**No**															
J1020110	J1020110 - UG Structures	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1020120	J1020120 - Support Structures	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1020130	J1020130 - Switch Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1020140	J1020140 - Sub Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1020150	J1020150 - Circuits	SUBSYSTEM	LF	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1030	**J1030 - Distribution**	**SYSTEM**	**•**	**Yes**															
J1030110	J1030110 - UG Structures	SUBSYSTEM	EA	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1030120	J1030120 - Support Structures	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1030130	J1030130 - Switch Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1030140	J1030140 - Sub Stations	SUBSYSTEM	EA	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J1030150	J1030150 - Circuits	SUBSYSTEM	LF	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K10	**K10 - Potable Water Utilities**	**MASTERSYSTEM**	**•**	**No**															
K1010	**K1010 - Production**	**SYSTEM**	**•**	**No**															
K1010110	K1010110 - Wells	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010120	K1010120 - Raw Water Service Area	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010130	K1010130 - Raw Water Pumping	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010140	K1010140 - Finished Water Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010150	K1010150 - Preliminary Treatment	SUBSYSTEM	EA	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010160	K1010160 - Coagulation Flocculation	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010170	K1010170 - Sedimentation	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010180	K1010180 - Adsorption	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010190	K1010190 - Filtration	SUBSYSTEM	EA	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010200	K1010200 - Chemical Treatment	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010210	K1010210 - Finished Water Pumping	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010220	K1010220 - Disinfection	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010230	K1010230 - Solids Handling	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010250	K1010250 - Plant Electrical	SUBSYSTEM	EA	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010260	K1010260 - Plant Water	SUBSYSTEM	EA	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010280	K1010280 - Plant Controls	SUBSYSTEM	EA	**Yes**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010290	K1010290 - Plant Compressed Air	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1010300	K1010300 - Raw Water Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1020	**K1020 - Distribution**	**SYSTEM**	**•**	**No**															
K1020100	K1020100 - Service Areas	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1020110	K1020110 - Pump Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K1020120	K1020120 - Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K20	**K20 - Non-Potable Water Utilities**	**MASTERSYSTEM**	**•**	**No**															
K2010	**K2010 - Production**	**SYSTEM**	**•**	**No**															
K2010110	K2010110 - Wells	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2010120	K2010120 - Water Supply Service Area	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2010130	K2010130 - Pump Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2010140	K2010140 - Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2010150	K2010150 - Plant Compressed Air	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2010160	K2010160 - Plant Controls	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2010180	K2010180 - Plant Electrical	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2020	**K2020 - Distribution**	**SYSTEM**	**•**	**No**															
K2020100	K2020100 - Service Areas	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2020110	K2020110 - Pump Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K2020120	K2020120 - Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K30	**K30 - Fire Protection Water Utilities**	**MASTERSYSTEM**	**•**	**No**															
K3010	**K3010 - Production**	**SYSTEM**	**•**	**No**															
K3010110	K3010110 - Wells	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3010120	K3010120 - Water Supply Service Area	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3010130	K3010130 - Pump Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3010140	K3010140 - Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3010150	K3010150 - Plant Compressed Air	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3010160	K3010160 - Plant Controls	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3010180	K3010180 - Plant Electrical	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3020	**K3020 - Distribution**	**SYSTEM**	**•**	**No**															
K3020100	K3020100 - Service Areas	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3020110	K3020110 - Pump Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K3020120	K3020120 - Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K40	**K40 - Salt Water Utilities**	**MASTERSYSTEM**	**•**	**No**															
K4010	**K4010 - Production**	**SYSTEM**	**•**	**No**															
K4010110	K4010110 - Wells	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4010120	K4010120 - Water Supply Service Area	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4010130	K4010130 - Pump Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4010140	K4010140 - Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4010150	K4010150 - Plant Compressed Air	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4010160	K4010160 - Plant Controls	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4010180	K4010180 - Plant Electrical	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4020	**K4020 - Distribution**	**SYSTEM**	**•**	**No**															
K4020100	K4020100 - Service Areas	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4020110	K4020110 - Pump Stations	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
K4020120	K4020120 - Storage	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L10	**L10 - Steam Utilities**	**MASTERSYSTEM**	**•**	**No**															
L1010	**L1010 - Production**	**SYSTEM**	**•**	**No**															
L1010100	L1010100 - Plant Electrical	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010110	L1010110 - Plant Water	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010120	L1010120 - Plant Steam	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010135	L1010135 - Plant Controls	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010140	L1010140 - Make-up Water	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010150	L1010150 - Boiler Feedwater	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010160	L1010160 - Boilers	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010170	L1010170 - Chemical Feed	SUBSYSTEM	EA	**No**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

L1010180	L1010180 - Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010190	L1010190 - Condensate and Blowdown	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010200	L1010200 - Fuel System	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010220	L1010220 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1010230	L1010230 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1020	**L1020 - Distribution**	**SYSTEM**	•	No																
L1020100	L1020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1020140	L1020140 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1020150	L1020150 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1030	**L1030 - Return**	**SYSTEM**	•	No																
L1030100	L1030100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1030110	L1030110 - Pump Station	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1030120	L1030120 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1030130	L1030130 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L20	**L20 - High Temp Hot Water Utilities**	**MASTERSYSTEM**	•	No																
L2010	**L2010 - Production**	**SYSTEM**	•	No																
L2010100	L2010100 - Plant Electrical	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010110	L2010110 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010120	L2010120 - Plant High Temp Hot Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010135	L2010135 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010140	L2010140 - Make-up Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010150	L2010150 - Boiler Feedwater	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010160	L2010160 - Boilers	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010170	L2010170 - Chemical Feed	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010180	L2010180 - Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010190	L2010190 - Condensate and Blowdown	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2010200	L2010200 - Fuel System	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2020	**L2020 - Distribution**	**SYSTEM**	•	No																
L2020100	L2020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2020110	L2020110 - Pump Station	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2020140	L2020140 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2020150	L2020150 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2030	**L2030 - Return**	**SYSTEM**	•	No																
L2030100	L2030100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2030110	L2030110 - Pump Station	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2030120	L2030120 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2030130	L2030130 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L30	**L30 - Domestic Hot Water Utilities**	**MASTERSYSTEM**	•	No																
L3010	**L3010 - Production**	**SYSTEM**	•	No																
L3010100	L3010100 - Plant Electrical	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010110	L3010110 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010120	L3010120 - Plant Domestic Hot Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010135	L3010135 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010140	L3010140 - Make-up Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010150	L3010150 - Boiler Feedwater	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010160	L3010160 - Boilers	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010170	L3010170 - Chemical Feed	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010180	L3010180 - Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010190	L3010190 - Condensate and Blowdown	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3010200	L3010200 - Fuel System	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3020	**L3020 - Distribution**	**SYSTEM**	•	No																
L3020100	L3020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3020110	L3020110 - Pump Station	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3020140	L3020140 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3020150	L3020150 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3030	**L3030 - Return**	**SYSTEM**	•	No																
L3030100	L3030100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3030110	L3030110 - Pump Station	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3030120	L3030120 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3030130	L3030130 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L40	**L40 - Chilled Water Utilities**	**MASTERSYSTEM**	•	No																
L4010	**L4010 - Production**	**SYSTEM**	•	No																
L4010100	L4010100 - Plant Electrical	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010110	L4010110 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010120	L4010120 - Plant Chilled Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010135	L4010135 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010140	L4010140 - Make-up Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010150	L4010150 - Chiller Feedwater	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010160	L4010160 - Chiller	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010170	L4010170 - Chemical Feed	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010180	L4010180 - Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010190	L4010190 - Condenser	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4010200	L4010200 - Fuel System	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4020	**L4020 - Distribution**	**SYSTEM**	•	No																
L4020100	L4020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4020110	L4020110 - Pump Station	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4020140	L4020140 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4020150	L4020150 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4030	**L4030 - Return**	**SYSTEM**	•	No																
L4030100	L4030100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4030110	L4030110 - Pump Station	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4030120	L4030120 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L4030130	L4030130 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M10	**M10 - Sanitary Sewer Utilities**	**MASTERSYSTEM**	•	No																
M1010	**M1010 - Production**	**SYSTEM**	•	No																
M1010100	M1010100 - Pump Stations	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010110	M1010110 - Equalization	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010120	M1010120 - Preliminary Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010130	M1010130 - Primary Clarification	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010140	M1010140 - Holding Tanks	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010150	M1010150 - Biological Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010160	M1010160 - Chemical Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010170	M1010170 - Secondary Clarification	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010180	M1010180 - Filtration	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010190	M1010190 - Disinfection	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010200	M1010200 - Sludge Dewatering	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010210	M1010210 - Sludge Disposal	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010220	M1010220 - Sludge Digestion	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010240	M1010240 - Plant Electrical	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010250	M1010250 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010270	M1010270 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1010280	M1010280 - Plant Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1020	**M1020 - Distribution**	**SYSTEM**	•	No																
M1020100	M1020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1020110	M1020110 - Storage	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

M1020120	M1020120 - Pump Stations	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M20	**M20 - Industrial Wastewater Utilities**	**MASTERSYSTEM**	•	No																		
M2010	**M2010 - Production**	**SYSTEM**	•	No																		
M2010100	M2010100 - Pump Stations	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010110	M2010110 - Equalization	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010120	M2010120 - Preliminary Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010130	M2010130 - Primary Clarification	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010140	M2010140 - Holding Tanks	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010150	M2010150 - Biological Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010160	M2010160 - Chemical Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010170	M2010170 - Secondary Clarification	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010180	M2010180 - Filtration	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010190	M2010190 - Disinfection	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010200	M2010200 - Sludge Dewatering	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010210	M2010210 - Sludge Disposal	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010220	M2010220 - Sludge Digestion	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010240	M2010240 - Plant Electrical	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010250	M2010250 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010270	M2010270 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2010280	M2010280 - Plant Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2020	**M2020 - Distribution**	**SYSTEM**	•	No																		
M2020100	M2020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2020120	M2020120 - Pump Stations	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M30	**M30 - Oily Wastewater Utilities**	**MASTERSYSTEM**	•	No																		
M3010	**M3010 - Production**	**SYSTEM**	•	No																		
M3010100	M3010100 - Pump Stations	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010110	M3010110 - Equalization	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010120	M3010120 - Preliminary Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010130	M3010130 - Primary Clarification	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010140	M3010140 - Holding Tanks	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010150	M3010150 - Biological Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010160	M3010160 - Chemical Treatment	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010170	M3010170 - Secondary Clarification	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010180	M3010180 - Filtration	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010190	M3010190 - Disinfection	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010200	M3010200 - Sludge Dewatering	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010210	M3010210 - Sludge Disposal	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010220	M3010220 - Sludge Digestion	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010240	M3010240 - Plant Electrical	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010250	M3010250 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010270	M3010270 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3010280	M3010280 - Plant Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3020	**M3020 - Distribution**	**SYSTEM**	•	No																		
M3020100	M3020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3020110	M3020110 - Storage	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3020120	M3020120 - Pump Stations	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M40	**M40 - Storm Water Utilities**	**MASTERSYSTEM**	•	No																		
M4010	**M4010 - Production**	**SYSTEM**	•	No																		
M4010100	M4010100 - Pump Stations	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M4010110	M4010110 - Storage	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M4010120	M4010120 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M4020	**M4020 - Distribution**	**SYSTEM**	•	No																		
M4020100	M4020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M4020110	M4020110 - Storage	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M4020120	M4020120 - Pump Stations	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N10	**N10 - Natural Gas Utilities**	**MASTERSYSTEM**	•	No																		
N1010	**N1010 - Production**	**SYSTEM**	•	No																		
N1010100	N1010100 - Plant Electric	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N1010110	N1010110 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N1010130	N1010130 - Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N1010140	N1010140 - Compressed Gas	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N1010150	N1010150 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N1020	**N1020 - Distribution**	**SYSTEM**	•	No																		
N1020100	N1020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N1020110	N1020110 - Storage	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N1020120	N1020120 - Pump Stations	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N20	**N20 - Propane Utilities**	**MASTERSYSTEM**	•	No																		
N2010	**N2010 - Production**	**SYSTEM**	•	No																		
N2010100	N2010100 - Plant Electric	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N2010110	N2010110 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N2010130	N2010130 - Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N2010140	N2010140 - Compressed Gas	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N2010150	N2010150 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N2020	**N2020 - Distribution**	**SYSTEM**	•	No																		
N2020100	N2020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N2020110	N2020110 - Storage	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N2020120	N2020120 - Pump Stations	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P10	**P10 - Compressed Air Utilities**	**MASTERSYSTEM**	•	No																		
P1010	**P1010 - Production**	**SYSTEM**	•	No																		
P1010100	P1010100 - Plant Electric	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P1010110	P1010110 - Plant Water	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P1010130	P1010130 - Compressed Air	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P1010140	P1010140 - Compressed Gas	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P1010150	P1010150 - Plant Controls	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P1020	**P1020 - Distribution**	**SYSTEM**	•	No																		
P1020100	P1020100 - Service Area	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P1020110	P1020110 - Storage	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P1020120	P1020120 - Pump Stations	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Q10	**Q10 - Multiple Commodity Utilities**	**MASTERSYSTEM**	•	No																		
Q1020	**Q1020 - Distribution**	**SYSTEM**	•	No																		
Q1020100	Q1020100 - Surface Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Q1020110	Q1020110 - UG Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Q1020120	Q1020120 - Support Structures	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R11	**R11 - LIQUID FUEL STORAGE - BULK**	**MASTERSYSTEM**	•	No																		
R1110	**R1110 - SHIP FUEL STORAGE**	**SYSTEM**	•	No																		
R111099	R111099 - SHIP FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R1120	**R1120 - AVIATION GASOLINE STORAGE**	**SYSTEM**	•	No																		
R112099	R112099 - AVIATION GASOLINE STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R1130	**R1130 - DIESEL FUEL STORAGE**	**SYSTEM**	•	No																		
R113099	R113099 - DIESEL FUEL STORAGE COMPONENT	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
R1140	**R1140 - MOTOR GASOLINE STORAGE**	**SYSTEM**	•	No																		
R114099	R114099 - MOTOR GASOLINE STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R1150	**R1150 - JET ENGINE FUEL STORAGE**	**SYSTEM**	•	No																		
R115099	R115099 - JET ENGINE FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R1160	**R1160 - LIQUEFIED PETROLEUM FUEL GAS STORAGE**	**SYSTEM**	•	No																		

R116099	R116099 - LIQUEFIED PETROLEUM FUEL GAS STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
R1170	**R1170 - VAPOR COLLECTION / RECOVERY SYSTEM**	**SYSTEM**	●	No																		
R117099	R117099 - VAPOR COLLECTION / RECOVERY SYSTEM COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
R1182	**R1182 - CONTAMINATED FUEL STORAGE**	**SYSTEM**	●	No																		
R118299	R118299 - CONTAMINATED FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
R1184	**R1184 - BULK (DEPOT) HEATING FUEL STORAGE**	**SYSTEM**	●	No																		
R118499	R118499 - BULK (DEPOT) HEATING FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
R1199	**R1199 - OTHER LIQUID FUEL STORAGE - BULK**	**SYSTEM**	●	No																		
R12	**R12 - LIQUID STORAGE OTHER THAN WATER, FUEL, AND PROPELLANTS**	**MASTERSYSTEM**	●	No																		
R1215	**R1215 - ROAD OIL STORAGE**	**SYSTEM**	●	No																		
R121599	R121599 - ROAD OIL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R1225	**R1225 - LUBRICANT STORAGE**	**SYSTEM**	●	No																		
R122599	R122599 - LUBRICANT STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R1235	**R1235 - BALLAST AND SLUDGE STORAGE**	**SYSTEM**	●	No																		
R123599	R123599 - BALLAST AND SLUDGE STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R1240	**R1240 - ORGANIC OIL STORAGE**	**SYSTEM**	●	No																		
R124099	R124099 - ORGANIC OIL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R1245	**R1245 - MISCELLANEOUS LIQUID STORAGE**	**SYSTEM**	●	No																		
R124599	R124599 - MISCELLANEOUS LIQUID STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R1250	**R1250 - INDUSTRIAL / POL WASTE STORAGE FACILITY**	**SYSTEM**	●	No																		
R125099	R125099 - INDUSTRIAL / POL WASTE STORAGE FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R1299	**R1299 - OTHER LIQUID STORAGE OTHER THAN WATER, FUEL, AND PROPELLANTS**	**SYSTEM**	●	No																		
R21	**R21 - AVIATION FUEL FACILITIES**	**MASTERSYSTEM**	●	No																		
R2110	**R2110 - AIRCRAFT DIRECT FUELING STATION**	**SYSTEM**	●	No																		
R211099	R211099 - AIRCRAFT DIRECT FUELING STATION COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R2120	**R2120 - AIRCRAFT TRUCK FUELING FACILITY**	**SYSTEM**	●	No																		
R212099	R212099 - AIRCRAFT TRUCK FUELING FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R2130	**R2130 - AIRCRAFT DEFUELING FACILITY**	**SYSTEM**	●	No																		
R213099	R213099 - AIRCRAFT DEFUELING FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R2150	**R2150 - AIRCRAFT READY FUELS STORAGE**	**SYSTEM**	●	No																		
R215099	R215099 - AIRCRAFT READY FUELS STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R2199	**R2199 - OTHER AVIATION FUEL FACILITIES**	**SYSTEM**	●	No																		
R22	**R22 - MARINE FUEL FACILITIES**	**MASTERSYSTEM**	●	No																		
R2210	**R2210 - MARINE FUELING FACILITY**	**SYSTEM**	●	No																		
R221099	R221099 - MARINE FUELING FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R2220	**R2220 - SMALL CRAFT FUELING STATION**	**SYSTEM**	●	No																		
R222099	R222099 - SMALL CRAFT FUELING STATION COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R2230	**R2230 - SMALL CRAFT READY FUEL STORAGE**	**SYSTEM**	●	No																		
R223099	R223099 - SMALL CRAFT READY FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R2299	**R2299 - OTHER MARINE FUEL FACILITIES**	**SYSTEM**	●	No																		
R23	**R23 - GROUND BASED VEHICLE AND EQUIPMENT FUEL FACILITIES**	**MASTERSYSTEM**	●	No																		
R2310	**R2310 - FILLING STATION**	**SYSTEM**	●	No																		
R231099	R231099 - FILLING STATION COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2315	**R2315 - FILLING STATION BUILDING**	**SYSTEM**	●	No																		
R231599	R231599 - FILLING STATION BUILDING COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2316	**R2316 - OVERHEAD COVER, AIRFIELD**	**SYSTEM**	●	No																		
R231699	R231699 - OVERHEAD COVER, AIRFIELD COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2317	**R2317 - OVERHEAD COVER, MISCELLANEOUS**	**SYSTEM**	●	No																		
R231799	R231799 - OVERHEAD COVER, MISCELLANEOUS COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2320	**R2320 - FILLING STATION SHELTER**	**SYSTEM**	●	No																		
R232099	R232099 - FILLING STATION SHELTER COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2323	**R2323 - VEHICLE AND EQUIPMENT READY FUEL STORAGE**	**SYSTEM**	●	No																		
R232399	R232399 - VEHICLE AND EQUIPMENT READY FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2340	**R2340 - ETHANOL READY FUEL STORAGE**	**SYSTEM**	●	No																		
R234099	R234099 - ETHANOL READY FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2350	**R2350 - BIODIESEL READY FUEL STORAGE**	**SYSTEM**	●	No																		
R235098	R235098 - POL PIPELINE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R235099	R235099 - BIODIESEL READY FUEL STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
R2399	**R2399 - OTHER GROUND BASED VEHICLE AND EQUIPMENT FUEL FACILITIES**	**SYSTEM**	●	No																		
R25	**R25 - POL DISTRIBUTION / PIPELINE FACILITIES**	**MASTERSYSTEM**	●	No																		
R2510	**R2510 - POL PIPELINE**	**SYSTEM**	●	No																		
R251099	R251099 - POL PIPELINE COMPONENT	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2516	**R2516 - POL PIPELINE PUMP STATION AND ANCILLARY EQUIP**	**SYSTEM**	●	No																		
R251699	R251699 - POL PIPELINE PUMP STATION AND ANCILLARY EQUIP COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2520	**R2520 - POL PIPELINE PUMP STATION BUILDING AND ANCILLARY EQUIP**	**SYSTEM**	●	No																		
R252099	R252099 - POL PIPELINE PUMP STATION BUILDING AND ANCILLARY EQUIP COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2530	**R2530 - SURGE STORAGE**	**SYSTEM**	●	No																		
R253099	R253099 - SURGE STORAGE COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2599	**R2599 - OTHER POL DISTRIBUTION / PIPELINE FACILITIES**	**SYSTEM**	●	No																		
R26	**R26 - OTHER LIQUID PETROLEUM PRODUCTS FACILITIES**	**MASTERSYSTEM**	●	No																		
R2610	**R2610 - DRUM AND CAN LOADING FACILITY**	**SYSTEM**	●	No																		
R261099	R261099 - DRUM AND CAN LOADING FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2615	**R2615 - PETROLEUM READY FUEL STORAGE FACILITY**	**SYSTEM**	●	No																		
R261599	R261599 - PETROLEUM READY FUEL STORAGE FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2630	**R2630 - TANK TRUCK OR TANK CAR LOADING FACILITY**	**SYSTEM**	●	No																		
R263099	R263099 - TANK TRUCK OR TANK CAR LOADING FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2640	**R2640 - TANK TRUCK OR TANK CAR UNLOADING FACILITY**	**SYSTEM**	●	No																		
R264099	R264099 - TANK TRUCK OR TANK CAR UNLOADING FACILITY COMPONENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
R2699	**R2699 - OTHER LIQUID PETROLEUM PRODUCTS FACILITIES**	**SYSTEM**	●	No																		
S10	**S10 - SPECIALIZED AND FLEET MOORINGS**	**MASTERSYSTEM**	●	No																		
S1010	**S1010 - SPREAD MOORING**	**SYSTEM**	●	No																		
S101001	S101001 - RISER TYPE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S101002	S101002 - RISER-LEG	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S1020	**S1020 - BUOY DOLPHIN**	**SYSTEM**	●	No																		
S102001	S102001 - RISER TYPE	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S102002	S102002 - RISER-LEG	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S1030	**S1030 - MED-MOOR**	**SYSTEM**	●	No																		
S103001	S103001 - RISER TYPE	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S103002	S103002 - RISER-LEG	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S1040	**S1040 - BOW-STERN MOORING**	**SYSTEM**	●	No																		
S104001	S104001 - RISER TYPE	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S104002	S104002 - RISER-LEG	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S1050	**S1050 - SINGLE POINT MOORING**	**SYSTEM**	●	No																		
S105001	S105001 - RISER TYPE	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S105002	S105002 - RISER-LEG	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
S1099	**S1099 - OTHER SPECIALIZED AND FLEET MOORINGS**	**SYSTEM**	●	No																		
U20	**U20 - ASHORE HYPERBARIC & DIVING FACILITIES**	**MASTERSYSTEM**	●	No																		
U2010	**U2010 - HYPERBARIC & DIVING AIR COMPRESSION**	**SYSTEM**	●	No																		
U201001	U201001 - HYPERBARIC & DIVING AIR COMPRESSORS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2020	**U2020 - HYPERBARIC & DIVING AIR STORAGE**	**SYSTEM**	●	No																		
U202001	U202001 - HYPERBARIC & DIVING HIGH PRESSURE AIR FLASKS	SUBSYSTEM	CF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U202002	U202002 - HYPERBARIC & DIVING MEDIUM PRESSURE AIR STORAGE TANKS	SUBSYSTEM	CF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2030	**U2030 - HYPERBARIC DIVING GAS STORAGE**	**SYSTEM**	●	No																		
U203001	U203001 - HYPERBARIC & DIVING HIGH PRESSURE OXYGEN FLASKS	SUBSYSTEM	CF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U203002	U203002 - HYPERBARIC & DIVING HIGH PRESSURE HELIUM FLASKS	SUBSYSTEM	CF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

U203003	U203003 - HYPERBARIC & DIVING HIGH PRESSURE NITROGEN FLASKS	SUBSYSTEM	CF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U203004	U203004 - HYPERBARIC & DIVING HIGH PRESSURE MIXED GAS FLASKS	SUBSYSTEM	CF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2040	**U2040 - HYPERBARIC & DIVING PIPING**	**SYSTEM**	•	No																
U204001	U204001 - HYPERBARIC & DIVING HIGH PRESSURE AIR PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204002	U204002 - HYPERBARIC & DIVING LOW PRESSURE AIR PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204003	U204003 - HYPERBARIC & DIVING AIR LP VOLUME TANKS	SUBSYSTEM	CF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204004	U204004 - HYPERBARIC & DIVING SURFACE SUPPLIED DIVING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204005	U204005 - HYPERBARIC & DIVING HIGH PRESSURE OXYGEN PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204006	U204006 - HYPERBARIC & DIVING LOW PRESSURE OXYGEN PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204007	U204007 - HYPERBARIC & DIVING HIGH PRESSURE HELIUM PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204008	U204008 - HYPERBARIC & DIVING LOW PRESSURE HELIUM PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204009	U204009 - HYPERBARIC & DIVING HIGH PRESSURE NITROGEN PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204010	U204010 - HYPERBARIC & DIVING LOW PRESSURE NITROGEN PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204011	U204011 - HYPERBARIC & DIVING HIGH PRESSURE MIXED GAS PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U204012	U204012 - HYPERBARIC & DIVING LOW PRESSURE MIXED GAS PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2050	**U2050 - RECOMPRESSION CHAMBER**	**SYSTEM**	•	No																
U205001	U205001 - RECOMPRESSION CHAMBER HULLS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205002	U205002 - RECOMPRESSION CHAMBER AIR PRESS. SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205003	U205003 - RECOMPRESSION CHAMBER BUILT IN BREATHING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205004	U205004 - RECOMPRESSION CHAMBER FIRE EXTING. SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205005	U205005 - RECOMPRESSION CHAMBER ATM. CONDITIONING SYSTEM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205006	U205006 - RECOMPRESSION CHAMBER COMMUNICATION SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205007	U205007 - RECOMPRESSION CHAMBER ELEC. SUPPORT SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205008	U205008 - RECOMPRESSION CHAMBER LIGHTING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U205009	U205009 - RECOMPRESSION CHAMBER AT. MONITORING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2060	**U2060 - LOCK OUT TRAINER**	**SYSTEM**	•	No																
U206001	U206001 - LOCK OUT TRAINER HULLS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U206002	U206002 - LOCK OUT TRAINER AIR PRESSURIZATION SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U206003	U206003 - LOCK OUT TRAINER BUILT IN BREATHING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U206004	U206004 - LOCK OUT TRAINER COMMUNICATIONS SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U206005	U206005 - LOCK OUT TRAINER ELECTRICAL SUPPORT SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U206006	U206006 - LOCK OUT TRAINER LIGHTING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U206007	U206007 - DIVERS MONITORING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2070	**U2070 - DIVING SIMULATION FACILITY**	**SYSTEM**	•	No																
U207001	U207001 - DSF HULLS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207002	U207002 - DSF AIR PRESSURIZATION SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207003	U207003 - DSF BUILT IN BREATHING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207004	U207004 - DSF DIVERS BREATHING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207005	U207005 - DSF FIRE EXTINGUISHING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207006	U207006 - DSF WETPOT FILL & DRAING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207007	U207007 - DSF COMMUNICATIONS SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207008	U207008 - DSF ATM. MONITORING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207009	U207009 - DSF ATM. CONDITIONING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207010	U207010 - DSF DIVERS MONITORING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207011	U207011 - DSF LIGHTING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207012	U207012 - DSF ELECTRICAL SUPPORT SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207013	U207013 - DSF SUPERVISORY CONTROL SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U207014	U207014 - DSF EMERGENCY BREATHING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2080	**U2080 - HYPERBARIC & DIVING CHARGING SYSTEMS**	**SYSTEM**	•	No																
U208001	U208001 - SCUBA CHARGING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U208002	U208002 - MK25 CHARGING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U208003	U208003 - MK16 CHARGING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U208004	U208004 - SEEDS & HEEDS CHARGING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U208005	U208005 - HABD CHARGING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U208006	U208006 - HALO FLASK CHARGING SYSTEMS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2090	**U2090 - HYPERBARIC & DIVING UNMANNED CHAMBER**	**SYSTEM**	•	No																
U209001	U209001 - HYPERBARIC & DIVING UNMANNED SYSTEM HULLS	SUBSYSTEM	SF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U209002	U209002 - HYPERBARIC & DIVING UNMANNED SYSTEMS CONTROL PIPING	SUBSYSTEM	LF	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
U2099	**U2099 - OTHER ASHORE HYPERBARIC & DIVING FACILITIES**	**SYSTEM**	•	No																
V10	**V10 - BRIDGE STRUCTURE**	**MASTERSYSTEM**	•	No																
V1010	**V1010 - SUBSTRUCTURE**	**SYSTEM**	•	No																
V101001	V101001 - FOUNDATIONS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V101002	V101002 - PIERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V101003	V101003 - ABUTMENTS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V1020	**V1020 - SUPERSTRUCTURE**	**SYSTEM**	•	No																
V102001	V102001 - RAILINGS	SUBSYSTEM	FT	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V102002	V102002 - DECKS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V102003	V102003 - BEAMS	SUBSYSTEM	FT	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V102004	V102004 - BEARINGS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V102005	V102005 - MOVABLE MECHANISM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V102006	V102006 - CULVERT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V1030	**V1030 - APPROACH**	**SYSTEM**	•	No																
V103001	V103001 - WINGWALLS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V103002	V103002 - RETAINING WALLS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V103003	V103003 - APPROACH SLABS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V1040	**V1040 - PROTECTION**	**SYSTEM**	•	No																
V104001	V104001 - EXPANSION JOINTS	SUBSYSTEM	FT	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104002	V104002 - WATERPROOFING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104003	V104003 - TOPPING OR OVERLAY (DECK OVERLAY)	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104004	V104004 - DRAINAGE	SUBSYSTEM	FT	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104005	V104005 - SLOPE WALLS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104006	V104006 - APPROACH BARRIERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104007	V104007 - CORROSION CONTROL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104008	V104008 - PIER PROTECTION BARRIERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V104009	V104009 - CHANNEL PROTECTION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
V1050	**V1050 - SERVICES**	**SYSTEM**	•	No																
V105001	V105001 - SIGNALS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V105002	V105002 - SIGNAGE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V105003	V105003 - LIGHTING	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V105004	V105004 - UTILITIES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

V105005	V105005 - GUARD TOWER	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V105006	V105006 - PAVEMENT MARKING	SUBSYSTEM	FT	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V1060	**V1060 - SITE WORK**	**SYSTEM**	•	No																	
V106001	V106001 - UTILITY RELOCATION	SUBSYSTEM	EA	Yes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V106002	V106002 - EXISTING STRUCTURES REMOVAL	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V106003	V106003 - EXCAVATION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V106004	V106004 - COFFERDAM	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V106005	V106005 - EMBANKMENT	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V106006	V106006 - TRAFFIC MAINTENANCE	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V106007	V106007 - ENVIRONMENTAL MITIGATION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V106008	V106008 - DEMOLITION	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
V1099	**V1099 - OTHER BRIDGE STRUCTURE**	**SYSTEM**	•	No																	
W10	**W10 - CATHODIC PROTECTION SYSTEM**	**MASTERSYSTEM**	•	No																	
W1010	**W1010 - IMPRESSED CURRENT CP**	**SYSTEM**	•	No																	
W101010	W101010 - RECTIFIERS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W101020	W101020 - ANODES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W101030	W101030 - TEST STATIONS/BOXES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W101040	W101040 - DIELECTRIC INSULATING COUPLINGS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W1020	**W1020 - GALVANIC CP**	**SYSTEM**	•	No																	
W102010	W102010 - ANODES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W102020	W102020 - TEST STATIONS/BOXES	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W102030	W102030 - DIELECTRIC INSULATING COUPLINGS	SUBSYSTEM	EA	No	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W1099	**W1099 - OTHER CATHODIC PROTECTION SYSTEM**	**SYSTEM**	•	No																	

REQUIRED FACILITY ASSET FIELDS

Position	Name	Responsible Party	Explanation
1	AssetNum	KTR	Asset identification used by the KTR to uniquely identify assets or equipment (e.g. FAN001, AHU003)
2	Description	KTR	Primary Asset Name (100 Character Limit)
3	Long Description	KTR	Additional Relevant Information (e.g. size, capacity, limits, etc…) (1000 Character Limit)
4	MASTERSYSTEM	DOR	Reference values from Model & Facility Data Matrix tab (MASTERSYSTEM)
5	SYSTEM	DOR	Reference values from Model & Facility Data Matrix tab (SYSTEM)
6	SUBSYSTEM	DOR	Reference values from Model & Facility Data Matrix tab (SUBSYSTEM)
7	Building Number	GVT	Current Building # in MAXIMO for renovation work. Will be provided by GVT for new construction
8	Asset Quantity	KTR	Quantity in correct unit of measure as defined in UOM field of the Model & Facility Data Matrix
9	Replacement Cost	KTR	Installed cost (material and labor)
10	Contract Number	GVT	Provided by GVT
11	Task/Delivery Order Number	GVT	Provided by GVT
12	Warranty Expiration Date	KTR	MM/DD/YYYY
13	Installation Date	KTR	MM/DD/YYYY
14	Room Number	KTR	Room Number of installed equipment
15	Manufacturer	KTR	Manufacturer name of installed equipment
16	Model	KTR	Model number of installed equipment
17	Serial #	KTR	Serial number of installed equipment

SAMPLE KTR FACILITY DATA FILE

Each facility component or piece of equipment will be a new row. Refer to Model & Facility Data Matrix tab for guidance on which fields are applicable to specific components & equipment.

Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Name	AssetNum	Description	Long Description	MASTERSYSTEM	SYSTEM	SUBSYSTEM	Building Number	Asset Quantity	Replacement Cost	Contract Number	Task/Delivery Order Number	Warranty Expiration Date	Installation Date	Room Number	Manufacturer	Model	Serial #
Explanation	Asset identification used by the KTR to uniquely identify assets or equipment (e.g. FAN001, AHU003)	Primary Asset Name (100 Character Limit)	Additional Relevant Information (e.g. size, capacity, limits, etc…) (1000 Character Limit)	Reference values from Model & Facility Data Matrix tab (MASTERSYSTEM)	Reference values from Model & Facility Data Matrix tab (SYSTEM)	Reference values from Model & Facility Data Matrix tab (SUBSYSTEM)	Current Building # in MAXIMO for renovation work. Will be provided by GVT for new construction	Quantity in correct unit of measure as defined in UOM field of the Model & Facility Data Matrix	Installed cost (material and labor)	Provided by GVT	Provided by GVT	MM/DD/YYYY	MM/DD/YYYY	Room Number of installed equipment	Manufacturer name of installed equipment	Model number of installed equipment	Serial number of installed equipment
	BA2201638	FOUNDATIONS, WALL FOOTINGS		A10 - FOUNDATIONS	A1010 - STANDARD FOUNDATIONS	A1010110 - STRIP FOOTINGS	WNY-212	552	$28,704.00				3/1/1942				
	BA2201640	FOUNDATIONS, STRUCTURAL SLAB ON GRADE		A10 - FOUNDATIONS	A1030 - SLAB ON GRADE	A1030120 - PLAIN/REINFORCED	WNY-212	17588	$105,528.00				3/1/1942				
	BA2201641	BASEMENT WALL CONSTRUCTION		A20 - BASEMENT CONSTRUCTION	A2020 - BASEMENT WALLS	A2020110 - CIP CONCRETE	WNY-212	764	$48,132.00				3/1/1942				
	BA2201642	FLOOR CONSTRUCTION, CONCRETE SLAB, PLANK (		B10 - SUPERSTRUCTURE	B1010 - FLOOR CONSTRUCTION	B1010220 - CIP CONCRETE BEAM AND SLA	WNY-212	66312	$1,193,616.00				3/1/1942				
	BA2201644	WOOD STRUCTURAL FRAME		B10 - SUPERSTRUCTURE	B1020 - ROOF CONSTRUCTION	B1020102 - WOOD DECK AND RAFTER	WNY-212	17588	$471,491.98				3/1/1970				
	BA2201645	STEEL STRUCTURAL FRAME		B10 - SUPERSTRUCTURE	B1020 - ROOF CONSTRUCTION	B1020108 - STEEL DECK, BEAMS AND BAR	WNY-212	17588	$257,079.25				3/1/1970				
	BA2201643	ROOF CONSTRUCTION, CONCRETE STRUCTURAL F		B10 - SUPERSTRUCTURE	B1020 - ROOF CONSTRUCTION	B1020122 - CIP CONCRETE ROOF CONSTR	WNY-212	17588	$140,704.00				3/1/1942				
	BA2201646	EXTERIOR WALLS, BRICK		B20 - EXTERIOR ENCLOSURE	B2010 - EXTERIOR WALLS	B2010125 - SOLID BRICK - SINGLE WYTHE	WNY-212	567	$14,175.00				3/1/1942				
	BA2201648	EXTERIOR WALLS, VINYL SIDING		B20 - EXTERIOR ENCLOSURE	B2010 - EXTERIOR WALLS	B2010148 - WOOD CLADDING W/STUD BAC	WNY-212	3486	$49,776.45				3/1/1990				
	BA2201647	EXTERIOR WALLS, STUCCO		B20 - EXTERIOR ENCLOSURE	B2010 - EXTERIOR WALLS	B2010151 - STUCCO WALL	WNY-212	20178	$322,848.00				3/1/1980				
	BA2201651	EXTERIOR WINDOWS (BA2201596)		B20 - EXTERIOR ENCLOSURE	B2020 - EXTERIOR GLAZED OPENINGS	B2020102 - WOOD WINDOWS	WNY-212	875	$1,890,436.37				3/1/1995				
	WNY212-01	EXTERIOR WINDOWS, ALUMINUM		B20 - EXTERIOR ENCLOSURE	B2020 - EXTERIOR GLAZED OPENINGS	B2020106 - ALUMINUM WINDOWS	WNY-212	395	$454,250.00				3/1/1995				
	BA2201653	DOORS, EXTERIOR METAL DOORS		B20 - EXTERIOR ENCLOSURE	B2030 - EXTERIOR DOORS	B2030220 - STEEL DOORS	WNY-212	4	$6,000.00				3/1/1942				
	BA2201654	ROOF, BUILT UP		B30 - ROOFING	B3010 - ROOF COVERING	B3010105 - BUILT-UP	WNY-212	16805	$168,050.00				3/1/1980				
	BA2201657	INTERIOR PARTITIONS - CMU WALLS		C10 - INTERIOR CONSTRUCTION	C1010 - PARTITIONS	C1010102 - CONCRETE BLOCK	WNY-212	5376	$69,888.00				3/1/1942				
	BA2201655	INTERIOR PARTITIONS - FRAMED WALLS		C10 - INTERIOR CONSTRUCTION	C1010 - PARTITIONS	C1010126 - DRYWALL W/STUD FRAMING	WNY-212	52656	$315,936.00				3/1/2000				
	BA2201660	DOORS, INTERIOR METAL		C10 - INTERIOR CONSTRUCTION	C1020 - INTERIOR DOORS	C1020114 - METAL DOOR	WNY-212	59	$15,367.68				3/1/1942				
	BA2201659	DOORS, INTERIOR WOOD		C10 - INTERIOR CONSTRUCTION	C1020 - INTERIOR DOORS	C1020120 - WOOD DOOR/WOOD FRAME	WNY-212	105	$81,574.31				3/1/1903				
	BA2201661	DOORS, INTERIOR GLAZED		C10 - INTERIOR CONSTRUCTION	C1020 - INTERIOR DOORS	C1020120 - WOOD DOOR/WOOD FRAME	WNY-212	4	$8,141.34				3/1/1903				
	WNY212-02	WALL FINISHES, WALL COVERINGS		C30 - INTERIOR FINISHES	C3010 - WALL FINISHES	C3010230 - WALL COVERING	WNY-212	4751	$23,755.00				3/1/2002				
	WNY212-03	WALL FINISHES, TILE		C30 - INTERIOR FINISHES	C3010 - WALL FINISHES	C3010380 - WALL TILE	WNY-212	4953	$59,436.00				3/1/1902				
	BA2201667	FLOORING, CARPET		C30 - INTERIOR FINISHES	C3020 - FLOORING	C3020901 - CARPET	WNY-212	66960	$334,800.00				3/1/1902				
	BA2201666	FLOORING, RESILIENT		C30 - INTERIOR FINISHES	C3020 - FLOORING	C3020903 - COMPOSITION SHEET	WNY-212	1390	$4,170.00				3/1/1902				
	BA2201665	FLOORING, TILE		C30 - INTERIOR FINISHES	C3020 - FLOORING	C3020910 - PORCELAIN TILE	WNY-212	2637	$23,733.00				3/1/1900				
	BA2201668	CEILING, DRYWALL / GYPSUM BOARD		C30 - INTERIOR FINISHES	C3030 - CEILING FINISHES	C3030110 - DRYWALL	WNY-212	2700	$13,500.00				3/1/2002				
	BA2201669	CEILING, TILE		C30 - INTERIOR FINISHES	C3030 - CEILING FINISHES	C3030210 - ACOUSTICAL	WNY-212	52201	$313,206.00				3/1/1942				
	BAN000003999	PASSENGER ELEVATORS		D10 - CONVEYING	D1010 - ELEVATORS AND LIFTS	D1010110 - HYDRAULIC ELEVATORS	WNY-212	1	$86,362.49				3/1/2000				
	BAN000003999	PASSENGER ELEVATORS		D10 - CONVEYING	D1010 - ELEVATORS AND LIFTS	D1010110 - HYDRAULIC ELEVATORS	WNY-212	1	$86,362.49				3/1/2000				
	BANC000020052	PASSENGER ELEVATORS	TENSION GEARED	D10 - CONVEYING	D1010 - ELEVATORS AND LIFTS	D1010110 - HYDRAULIC ELEVATORS	WNY-212	1	$140,000.00				3/1/2000				
	CONV001W212	CONVERTER		D30 - HVAC	D3020 - HEAT GENERATING SYSTEMS	D3020999 - OTHER	WNY-212	1	$2,345.00			3/1/1992		1ST FL MER	BELL AND GOSSETT	SU-127-2	125693
	CONV002W212	Cooling Generating Systems,Condenser, DX, Air Cooled,I		D30 - HVAC	D3020 - HEAT GENERATING SYSTEMS	D3020999 - OTHER	WNY-212	1	$1,875.00			3/1/1992		1ST FL MER	AMTROL, INC.	S8842A	25281
	CHIL004W212	CHILLER, RECIP AIR COOLED - ROOF		D30 - HVAC	D3030 - COOLING GENERATING SYSTEMS	D3030135 - CHILLER, RECIP, AIR COOLED	WNY-212	1	$53,000.00			3/1/1996		ROOF	CARRIER	30GXR249A5	1902F52592
	COND003W212	CONDENSER, DX, AIR COOLED		D30 - HVAC	D3030 - COOLING GENERATING SYSTEMS	D3030901 - CONDENSER, DX, AIR COOLED	WNY-212	1	$8,268.75			3/1/2006		W ROOF	LENNOX	PFG10	T04E00710

KTR FACILITY DATA FILE

Each facility component or piece of equipment will be a new row. Refer to Model & Facility Data Matrix tab for guidance on which fields are applicable to specific components & equipment.

Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Name	AssetNum	Description	Long Description	MASTERSYSTEM	SYSTEM	SUBSYSTEM	Building Number	Asset Quantity	Replacement Cost	Contract Number	Task/Delivery Order Number	Warranty Expiration Date	Installation Date	Room Number	Manufacturer	Model	Serial #
Explanation	Asset identification used by the KTR to uniquely identify assets or equipment (e.g. FAN001, AHU003)	Primary Asset Name (100 Character Limit)	Additional Relevant Information (e.g. size, capacity, limits, etc…) (1000 Character Limit)	Reference values from Model & Facility Data Matrix tab (MASTERSYSTEM)	Reference values from Model & Facility Data Matrix tab (SYSTEM)	Reference values from Model & Facility Data Matrix tab (SUBSYSTEM)	Current Building # in MAXIMO for renovation work. Will be provided by GVT for new construction	Quantity in correct unit of measure as defined in UOM field of the Model & Facility Data Matrix	Installed cost (material and labor)	Provided by GVT	Provided by GVT	MM/DD/YYYY	MM/DD/YYYY	Room Number of installed equipment	Manufacturer name of installed equipment	Model number of installed equipment	Serial number of installed equipment

SECTION 01 80 10

SUMMARY OF WORK FOR P964
WATER TREATMENT EQUIPMENT EXPANSION

10/19

PART 1 GENERAL

1.1 BACKGROUND

Naval Support Activity II(NSA), Bahrain is equipped with a water treatment system that produces potable water from a surface water intake. The existing system includes two media filtration units, two reverse osmosis (RO) trains, and supporting equipment. The RO trains operate in a duty standby configuration where each RO train produces approximately 624 liters per minute (lpm) of potable water.

This work includes the supply and installation of one additional media filtration unit (pressure filter), one additional RO train, and one control panel to the existing water treatment system along with all necessary valves, piping, electrical instrumentation and controls necessary to increase the capacity of the system up to 1,248 lpm with one RO train and one pressure filter on standby. The system controls shall be upgraded to control running the three Multi-Media Filters in either single, duplex or triplex mode to support one, two, or all three RO trains to be in operation simultaneously with the media filters and RO trains interlocked with the existing raw water and backwash pumps and the water tank level sensors.

1.2 GENERAL

a. This section covers the Work to be performed by the Contractor in order to upgrade and increase the capacity of the water treatment system at NSA II Bahrain. Major equipment additions to the water treatment system include one new pressure filter, one new RO train, and one new control panel (Control Panel #3 or CP3). Details of the new pressure filter are included in specification 46 61 00, and the details of the new RO train are specified herein. The new RO train will have a permeate capacity of 624 lpm, and the new pressure filter will have a permeate capacity of 832 lpm. Design, fabricate, ship to the NSA II site and install the major equipment additions and any auxiliary equipment necessary for a complete working water treatment system. The Contractor shall startup and test the entire expanded water treatment system and shall be held responsible for the new control programming, and performance of the new equipment additions including any new auxiliary equipment necessary for a complete working water treatment system.

b. Furnish a workmanship and materials warranty to the Government as specified herein.

c. The Contractor shall coordinate suppliers and subcontractors for integration of all equipment and facilities, as appropriate, to provide a complete and well-functioning system.

d. Provide similar types/models/manufacturers of equipment including instruments that are currently installed in the NSA II water treatment

system.

e. All control signals from the new RO train and new multi-media pressure filter (pressure filter) valves, instruments, and other contact or analog devices shall be neatly wired to a new Contractor provided Control Panel (Control Panel #3 or CP3)to be placed adjacent to the new RO train per drawing D-101. All wiring shall be placed in raceways or conduit. Loosely hanging exposed cables are not acceptable.

f. CP3 shall consist of similar human machine interface (HMI)/Operator Interface Terminal (OIT) screen, buttons and switches as the existing CP1 and CP2. The RO trains will be controlled using a programmable logic controller (PLC) based control system. CP3 is to be SCADA ready, but control of the water treatment system will be local via Control Panels CP1, CP2, CP3, and CP4. The new CP3 shall be integrated into the existing control system. The control system will be upgraded to allow the operator to either:

(1) Produce 624 lpm with one RO train in operation and two RO trains on standby, or

(2) Produce 1,248 lpm with two RO trains in operation and one RO train in standby, or

(3) Produce 1,872 lpm with all RO trains in operation.

See sections 2.3.4 and 3.6 below for additional details on the control system.

g. The RO train and pressure filter provided under this specification and specification 46 61 00 shall be complete and operable in all respects including, but not limited to, connections to other facilities, lubricants, component and system tests, calibration, alignment, and adjustments as necessary to place the system in operation to perform the intended function.

h. Expand the existing NSA II Consolidated Utility Building (CUB) as specified elsewhere under this contract. Provide the new pressure filter, RO train and CP3 in locations depicted on drawing D-101. Pour a concrete pad under the new RO train to match the existing pads under the existing RO trains. Provide all interconnecting piping required for a complete system including, but not limited to the relocation of the combined product water piping on the new east wall of the CUB and a connection to the exiting RO brine effluent piping (underground).

The existing post treatment equipment including the sodium hypochlorite system, static mixers, piping, post treatment chemical injection points and finished water instrumentation in the CUB will all need to be relocated as depicted in drawing D-602 note A and placed on the new east wall. The chemical injection is all double contained and both the injection and double containment tubing will need to be replaced as each will need to be lengthened for each chemical.

Provide a ball valve and camlock hose connection to the common permeate piping prior to remineralization chemical addition, as depicted on drawing D-602, for periodic manual operator filling of the existing RO clean in place (CIP) system.

i. Provide all equipment and other components required for a complete water treatment system.

1.2.1 Additional Requirements

As-built drawings, framed instructions, and the Operation and Maintenance Manuals shall be updated where impacted by this work, in accordance with the contract documents. As Built Piping and Instrumentation Diagrams will include unique tag numbers for all existing and new equipment.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications may be referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/FCI 70-2	(2006) Standard for Control Valve Seat Leakage
ANSI B16.5	(1996) Standard for Pipe Flanges and Flanged Fittings
ANSI B16.9	(2001) Standard for Factory-Made Wrought Steel Butt-welding Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C653-13	(2016); Disinfection of Water Treatment Plants

ASME INTERNATIONAL (ASME)

ASME B40.100	(2013) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A182/A182M	(2019) Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M	(2017) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2018) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A240/A240M	(2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A276	(2010) Standard Specification for Stainless Steel Bars and Shapes
ASTM A312/A312M	(2017) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A351/A351M	(2018) Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A403/A403M	(2019) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM B912	(2018) Standard Specification for Passivation of Stainless Steels Using Electropolishing
ASTM D1784	(2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2467	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D4516	(2000) Standard Practice For Standardizing Reverse Osmosis Performance Data

COMMANDER, NAVY INSTALLATIONS COMMAND

CNIC M-5090.1	(2009) Navy Overseas Drinking Water Program Ashore Manual

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ANSI/ISA 5.1	(2009) Instrumentation Symbols and Identification

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-43	(2019) Wrought and Fabricated Butt-Welding

	Fittings for Low Pressure, Corrosion Resistant Applications
ANSI/MSS SP-58	(2018) Pipe Hangars and Supports
ANSI/MSS SP-69	(2019) Pipe Hangars and Supports - Selection and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2016; SUPP 2016) Motors and Generators

NSF INTERNATIONAL (NSF)

NSF/ANSI 61	(2017) Drinking Water System Components - Health Effects

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.4 DESCRIPTION OF OVERALL TREATMENT PROCESS

a. The new water treatment facilities will be located in the expanded CUB. Regarding water treatment equipment, the CUB currently houses two media filtration units, two RO trains, chemical dosing equipment, and a RO clean in place skid. The chemical dosing equipment includes sodium bisulfite for neutralizing residual chlorine in the raw feed water and sodium hypochlorite, zinc orthophosphate, and sodium carbonate for RO permeate remineralization and disinfection. In addition, each RO train includes antiscalant addition equipment to the RO feed water to inhibit the scaling of sparingly soluble salts.

b. Drawings D-601, D-602, D-603, display the piping and instrumentation diagrams for the bulk of the water treatment system. Raw water is directed to a storage tank and subsequently pressurized by a set of Filter Feed Pumps. The Filter Feed Pump effluent is directed to the pressure filters for removal of settleable and suspended solids. Pressure filter filtrate is dosed with sodium bisulfite for oxidant neutralization and directed to the RO trains for salt, bacteria and protozoa removal. Additional RO pretreatment includes antiscalant addition and cartridge filtration. The RO trains currently operate in a duty/standby configuration. The combined RO permeate from the individual trains is dosed with remineralization chemicals and directed to the Product Water Storage Tank. A set of Domestic Pumps distribute the potable water throughout the NSA II Facility. The RO brine is directed to drain. The Product Water Storage Tank is also the source for the backwash of the pressure filters via a set of filter backwash pumps, and the backwash effluent is, like the RO brine, directed to drain.

c. One new pressure filter shall be added in parallel to the existing two pressure filters, and one new RO treatment train shall be added in parallel to the existing two RO treatment trains as shown drawings D-601, D-602, D-603 and D-101.

d. The new RO train will have a dedicated RO feed pump. For detailed pump information, see Section 35 45 01, Vertical Turbine Pumps. Each membrane feed pump motor will be driven with an adjustable frequency drive (AFD). See Section 26 20 00, Low-Voltage AC Induction Motors, and Section 26 29 23, Low-Voltage Adjustable Frequency Drive Systems.

e. The membrane elements installed in the new trains will be composite type membranes and, therefore, should not be exposed to free chlorine or other strong oxidants, which may cause membrane damage.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation, and approval is a condition to acceptance of the Final Design and release for construction; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shop Drawings, catalog cuts, and other information required to completely describe the system and equipment shall be submitted to the Government within 60 days of the Notice-to-Proceed. The following information shall be included as a part of this submittal

-Membrane element and pressure vessel catalog cut sheets, including a certified statement from the membrane manufacturer specifying the active membrane area for the proposed membrane element model.

-Technical bulletins from the membrane manufacturer describing chemical solutions and protocols for membrane cleaning, short-term storage, and long-term storage.

-Media information including manufacturer, model, uniformity coefficient and amount to be supplied.

SD-02 Shop Drawings

The following specified information shall be provided to the Government within 120 days following Notice-to-Proceed

-A plan view layout and elevation drawings (all four sides) showing RO train membrane pressure vessel, piping headers and manifolds, instrumentation sampling/pipe tap points, and interfaces with piping. Show location of all instrumentation and power terminal junction boxes. Show all dimensions, parts, construction details, materials of construction, and bill-of-materials.

-Control, electrical and instrument information.

-Control valve sizing calculations, piping materials and instrument information.

-Field and installation information, including mounting requirements, sampling locations, access, approximate total weight of RO train, pressure media filter and CP3 and required conduit size and routing.

-CP3 layout drawings and wiring diagrams. Show all dimensions, parts, construction details, materials of construction, and bill-of-materials.

-Proposed diagrams, instructions, and other sheets, prior to posting. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

SD-03 Product Data

All membrane element test data for the manufacturer's standard factory tests for each RO membrane element supplied.

Test and calibration data sheets for all instruments certifying calibration.

SD-05 Design Data

Submit design calculations prepared by a licensed professional structural engineer that certify that the RO train, media filter and CP3 shall meet the structural requirements conforming to Seismic Design Category B.

SD-10 Operation and Maintenance Data

-Detailed field testing and commissioning plan.

- o Submit Operation and Maintenance Manuals.
- o Contractor qualification statements, including resumes of key personnel involved in the commissioning and startup.
- o QC inspector's and QC laboratory's qualification statements including resumes of key personnel involved in the membrane installation.

SD-11 Closeout Submittals

As-Built Drawings

Final as-built drawings.

Certification by an independent third-party organization that all interior coating and materials that come in contact with the brackish or potable water comply with NSF/ANSI 61.

System Pressure and leak test

Test results from commercial laboratory verifying system disinfection.

1.6 MEMBRANE SYSTEM PERFORMANCE CRITERIA

1.6.1 Water Quality Analyses

a. Water analyses shall be conducted in accordance with the appropriate approved methods in the latest edition of "Standard Methods for the Examination of Water and Wastewater (Standard Methods)," except as otherwise approved by the Engineer.

b. The total dissolved solids (TDS) concentration (for warranty purposes) shall be calculated by adding the concentrations of calcium, magnesium, sodium, potassium, 50 percent of bicarbonate, sulfate, chloride, and silica.

c. The total ions plus silica concentration shall be calculated by adding the concentrations of all of the ions shown in Table 1 plus silica.

d. Raw Water

(1) NSA purchases treated water from the Kingdom of Bahrain Electricity and Water Authority. The water received at the Site is supplied by the Al-Hidd power and seawater desalination plant through the Manama City Juffair district distribution system. The Department of the Navy (Navy) further treats the water supply because the water source is surface water, requiring filtration for removal of microbial contamination and suspended solids by 2012 Bahrain Final Governing Standards (FGS) and CNIC M-5090.1.

(2) The raw water was sampled at NSAII on May 28, 2018. Table 1 below indicates the water quality on this date and is considered typical:

Table 1 NSA II Raw Feed Water Quality May 28, 2018

Parameter	Result
Calcium (mg/L)	38
Magnesium (mg/L)	0.5
Sodium (mg/L)	17
Potassium (mg/L)	< 0.3
Ammonia (mg/L)	< 0.1
Bicarbonate (mg/L)	146
Sulfate (mg/L)	0.5
Chloride (mg/L)	4.6
Nitrate (mg/L)	3.8
Fluoride (mg/L)	< 0.1

Table 1 NSA II Raw Feed Water Quality May 28, 2018	
Parameter	Result
Silica (mg/L)	< 0.01
Iron (mg/L)	< 0.01
Manganese (mg/L)	< 0.0015
Phosphate (mg/L)	< 0.2
Boron (mg/L)	< 0.02
Total Dissolved Solids (mg/L)	152
pH	7.9
Temperature (F)	84
Turbidity (NTU)	< 1
Total Coliforms (CFU/100mL)	< 1

(3) New pressure filter unit filtrate and RO train permeate water quality criteria requirement at start-up, and throughout the onsite initial Performance Testing period when operating the RO at 78 percent recovery and 624 lpm permeate flow rate, shall meet the following:

Table 2 New Pressure Filter Filtrate and New RO Train Permeate (Before Remineralization) Throughout the Performance Testing (Maximum Allowable Values) |1|	
Parameter	Result Throughout the Initial Performance Test
Pressure Filter Filtrate 15 minute silt density index (SDI15)	< 5
RO Permeate turbidity (NTU)	< 0.3 95 percent of the time Always < 1.0
RO permeate Total Dissolved Solids |2| (mg/L)	< 20
|1| RO Train values based on 78 percent recovery and the assumed water quality and temperature specified in Table 1 |2| TDS = Total dissolved solids for warranty purposes, as defined in this section	

(4) The permeate conductivity from each new RO train pressure vessel shall be within plus or minus 20 percent of the average conductivity of the combined permeate for the stage of the train in which it is installed.

1.7 OPERATIONS AND MAINTENANCE MANUAL

a. Provide a comprehensive operations and maintenance manual for the system specified herein, including operation and maintenance of the media and RO membrane elements. The manual shall also include clearly defined critical and reasonable operating criteria that may, if not met, result in irreversible RO membrane damage. Operating criteria shall be based on membrane manufacturer's requirements, typical industry practices, and procedures for approval by Contractor and Government.

b. Provide operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of equipment and their basic operating features. Provide specific instruction for individual pressure vessel permeate probing for system integrity verification. Also, provide maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the system as installed. The manual shall require all valves be numbered and tagged and shall provide a schematic indicating the number of each valve. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the facility, name of the Contractor, and contract number.

1.8 WARRANTY

1.8.1 Materials Warranty

Workmanship and Materials: Warrant the new equipment components provided herein. The components shall be manufactured from all new materials and designed and constructed for potable water production and shall be free of defects in material and workmanship under normal conditions for 1 year after acceptance and free from liens and encumbrances. Should any defect in material and workmanship be discovered within 1 year, the deficient item(s) shall be repaired or replaced by the Contractor, at no cost to the Government.

1.8.2 Special Membrane Element Performance Warranty:

Contractor shall furnish a separate warranty for the RO membrane elements obtained from the membrane manufacturer.

1. The membrane elements supplied under these specifications shall be warranted by manufacturer to be free of liens and encumbrances, and against defects in materials or workmanship for a period of twelve (12) months. If any membrane elements should fail to meet the warranted performance listed above in Table 2 or due to a defect in material or workmanship during the initial twelve month warranty period the elements shall be either repaired or replaced at no cost to the Government. The warranty period shall commence on successful completion of the performance demonstration test.

2. The manufacturer shall also warrant the performance of the membrane elements for a total period of four (4) years from completion of the performance demonstration test. The manufacturer shall guarantee the

membrane elements during that four (4) year period in accordance with the performance requirements specified herein and the following prorated replacement conditions if the elements fail to meet the warranted performance listed above in Table 2.

3. It is understood that the Government is obligated to operate the membrane system within critical operating criteria (submitted by the Contractor and approved by the Engineer and Government prior to initial startup) which shall be clearly defined in the Operations and Maintenance Manual.

4. Should the actual performance for the RO train fail to meet all system performance criteria, as specified, the Contractor shall provide new replacement elements on a prorated cost basis after the first 12 months following the performance demonstration test (market price per element, less a credit of 1/36 of the purchase price for each unused month of the warranty period) to restore performance to warranted levels. The Government's cost for said replacements shall be limited to the standard commercial price per element at that time, or $450 (USD) base price per 8-inch diameter, 40-inch long element (adjusted by the Federal Consumer Price Index at the time of the warranty claim) whichever is more minus a prorated rebate on the unrealized life of the warranty period. The Government shall be responsible for the cost of shipping the membrane element replacements to the treatment plant site and for installation labor. The prorated rebates shall be based on 1/36 of the cost per month for each month remaining in the 4-year warranty period (after the initial twelve months following the performance demonstration test).

The guaranteed membrane system performance shall be based on design raw waters specified in Table 1. For the constituents specifically listed in the permeate water quality criteria specified herein, if the actual raw water has constituent concentration(s) greater than the applicable Design Average TDS raw water quality value(s) shown in Table 1, then for purposes of determining compliance with this performance warranty, the corresponding permeate quality concentration for TDS shall be increased in the same proportion that the applicable raw water constituent(s) exceeds the design concentration(s). If the required feed pressure to produce specified permeate flow rate exceeds the maximum allowable pressure specified herein and the actual raw water TDS exceeds the applicable design concentration(s) or raw water temperature varies from the design value, for purposes of determining compliance with this performance warranty, an "adjusted" applied pressure shall be used based on ASTM D4516, Standard Practice for Standardizing Reverse Osmosis Performance Data and using the applicable design TDS raw water quality.

1.9 QUALIFICATIONS

Submit qualifications of the installer and the RO train supplier.

1.9.1 Installer

The installer shall have a minimum of 5 years' experience in the installation of a minimum of 5 similar filtration systems and shall show evidence of satisfactory operation for each installation.

1.9.2 RO Train Supplier

The RO Train supplier shall have provided a minimum of 5 successful RO

installations of similar complexity over the last 5 years. The demonstrated ability to provide successful equipment must be documented with questionnaires from customers indicating the capacity of the RO, feed water quality, permeate characteristics, date of install, number of membranes, membrane supplier, and number of years of successful operation. Successful installation is defined, as operation must meet a minimum of one (1) year prior to the date of the solicitation producing the stated quantity and quality.

1.9.3 Supplier's Representative

A representative of the RO Train supplier, who is familiar with the design and experienced in the installation, adjustment, and operation of the equipment specified shall be present at the jobsite during installation of the RO Train.

PART 2 PRODUCTS

2.1 GENERAL

All wetted materials with direct contact with brackish or processed water shall be in conformance with American National Standards Institute (ANSI)/NSF International (NSF) NSF/ANSI 61.

2.2 EQUIPMENT DESCRIPTION

a. Provide one new RO membrane train, one new pressure filter and one new control cabinet as well as all equipment and other components required for a complete integrated system as described in the contract specifications and Drawings. The intent is to match the existing equipment as much as possible. See the figures in the attachment at the end of this section for existing equipment.

b. New RO Membrane Train

(1) Provide the following in the new RO membrane train:

(a) Antiscalant storage and chemical injection system (double contained); cartridge filter; RO Membrane elements and pressure vessels (203 mm nominal diameter); support frame; piping and valves for feed, concentrate, and permeate for each stage, and connections for membrane cleaning; sample valves, tubing; instrumentation and instrumentation cabinet; electrical and other items as specified herein and/or shown on the drawing D-602 or Figures 1-6 in the attachment at the end of this section.

(b) All required components for a complete installation, including but not limited to, appropriate anchor bolts, piping supports, hardware, surface preparation, and shop and field painting.

(2) The new RO membrane train shall meet the following criteria:

(a) Have a permeate capacity of 624 lpm.

(b) Have an array of 5 x 2 6M (6 membranes per pressure vessel) pressure vessels.

(c) Have 2 stages and be designed for 75 to 80 percent recovery.

(d) Have an overall flux not greater than 26 liters per square meter per hour.

(e) Nominal 203 mm diameter reverse osmosis membrane elements shall be designed to be loaded into 203 mm nominal diameter pressure vessels capable of holding six 203 mm diameter, 1,016 mm long (approximate) elements.

(f) A total of 43 RO membrane elements shall be fabricated, tested, packaged, shipped to the project site and installed (includes one spare). RO membrane elements shall:

1. Be spiral wound with the feed and concentrate flow through the element parallel to the central product water tube of the element. Each element shall have nominal dimensions of 203 mm in diameter and 1,016 mm in length.

2. Be designed to operate at pressures up to 41.3 bar minimum.

3. Be complete with brine seals, interconnectors, O-rings, spacers, and any adapters necessary to make the membrane fully compatible with the pressure vessels supplied. O-rings and brine seals shall be constructed of ethylene propylene rubber and shall be standard products available from vendors other than the membrane manufacturer.

4. Have a fiberglass reinforced plastic outer wrap.

5. Be thin film composite and shall be designed to achieve the following when tested at 15 percent recovery with a feed pressure of 10 bar on a standard solution of 1500 mg/L NaCl solution at 25 degrees C, 6.5 < pH < 7:

   37.8 cubic meters per day permeate production

   > 99.5 percent NaCl rejection

6. Have an active membrane area of 37.2 square meters, each.

7. Have a nominal feed-concentrate channel spacer with a thickness of 0.67 millimeters or greater.

8. Be fully compatible with the pressure vessels furnished.

9. Submit

   Membrane element and pressure vessel catalog cut sheets, including a certified statement from the membrane manufacturer specifying the active membrane area for the proposed membrane element model.

   Technical bulletins from the membrane manufacturer describing chemical solutions and protocols for membrane cleaning, short-term storage, and long-term storage.

(g) The RO train (RO Train 3), with limits shown on drawing D-602, shall fit within the space limits shown on drawing D-101 and shall not exceed the following overall dimensions:

1. Length: 7.9 meters maximum.

2. Width: 2.4 meters maximum.

3. Height (frame): 2.1 meters maximum.

(3) RO Train framework shall be designed to support "6M" pressure vessels (which hold six nominal 203 mm by 1,016 mm membrane elements) at three points per manufacturer's recommendations.

(4) One cartridge filter vessel shall be supplied with fiberglass reinforced plastic materials of construction with EPR seals. Bolting shall be 316 stainless steel. Cartridge filter vessel shall be rated for 10 bar working pressure, constructed per ASME Boiler constructed per ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and shall be code stamped. The cartridges shall be rated for 90 percent (minimum) removal of 5 micron-size particles.

(5) The membrane pressure vessels shall be designed and constructed in accordance with the latest edition of the ASME Boiler and Pressure Vessel Code, Section X, FIBERGLASS - REINFORCED PLASTIC PRESSURE VESSELS, shall be code-stamped. As a minimum each vessel shall have the following features:

(a) Pressure vessels shall have a diameter and length so as to contain multiple nominal 203 mm diameter, 1,016 mm length spiral wound membrane elements. Each vessel shall be of sufficient length to house six membrane elements (i.e., 6M pressure vessel).

(b) The pressure vessels shall either be the side port entry type and or endcap entry type and shall be fabricated of filament wound fiberglass reinforced plastic (FWFRP) using continuous glass roving impregnated with an elevated temperature cure epoxy resin system. Materials of construction shall be lot traceable to vessel serial number. All wetted components in continuous contact with the pressurized process water shall be made from plastic or Type 316L stainless steel metal (or other metal proven to have long term resistance to corrosion greater than Type 316L stainless steel in the service intended). All materials of construction shall be of appropriate strength and corrosion resistance for the operating conditions. The materials of construction for each component part of the vessel shall be clearly and fully specified on the engineering drawing included with the submittal documentation for the vessels.

(c) Vessels shall have a maximum working pressure of not less than 20.7 bar at a temperature of not less than 49 C with a minimum operating temperature not greater than -6.7 C. The pressure vessels shall be supported from below and shall rest on elastomer support saddles.

(d) Each shell inside diameter shall be free of pits or voids and shall conform to acceptance Level 1 criteria as defined in ASME Section V, Article 28, SD2563. The bore diameter shall be a mirror-like smooth surface and meet the following measurement criteria throughout the membrane interface area: 203 plus or minus 0.13 mm for nominal 203 mm diameter vessels.

(e) The shell exterior surface shall be smooth with polyurethane enamel (which blocks light) and shall be free of grinding and sanding marks.

(f) The vessels shall be designed to allow industry-standard sized nominal 203 mm by 1,016 mm membrane elements to be easily accommodated by changing end connectors (adapters) and spacers (to prevent movement of the elements within the vessels). Furnish the appropriate end connectors (adapters).

(g) Vessels shall be so designed as to allow membrane elements to be connected to the permeate port at either end of the vessel so that permeate can be taken from either end.

(h) Permeate ports shall be located in the vessel end caps. Each port shall be designed with an anti-rotation mechanism so that piping may be easily tightened without the use of special retention tools.

(i) Vessels shall be complete with end closures, mounting hardware and membrane element adapters. The element adapters furnished shall be appropriate for the brand of membrane element furnished for this project. However, the vessel shall be so designed as to allow other makes of membrane element to be easily accommodated by changing adapters.

(j) One set of special tools available from the Pressure Vessel Manufacturer shall be provided which aids end cap and/or membrane element installation and removal.

(k) Five pressure vessel shims shall be provided for each pressure vessel (45 total). The shims shall be 5.1 mm thick, have machined surfaces and be manufactured from a plastic material suitable for this service. Elements shall be shimmed on the feed end of each vessel to minimize movement of the elements within the vessel.

(l) One complete set of permeate orifice plugs and blind plugs shall be supplied for operating the RO trains at design flow without membrane elements. Supply 7 drilled plugs and 9 plain plugs that fit the element adapter ports on the pressure vessels. The plugs (undrilled) shall be a product of the pressure vessel manufacturer to ensure compatibility with end adapters furnished.

(6) Antiscalant equipment shall consist of two mechanical diaphragm pumps each rated at 91 liters per day at 6.8 bar, one 40 liter HDPE tank, one antiscalant tank level low level switch, one double containment bin with a capacity of at least 100 liters, chemical injection tubing and double containment tubing for chemical injection.

(a) The mechanical diaphragm pumps shall operate in a duty/standby configuration where the speed of the pumps will be increased or decreased automatically to maintain chemical dose based upon:

1. The RO train feed water flow

2. Operator inputs into the PLC/HMI system for:

i. Antiscalant dose (0 - 10 mg/L)
ii. Antiscalant chemical concentration (0-100 percent)
iii. Antiscalant specific gravity (0-2.0)
iv. Antiscalant pump capacity (0-91 LPD)
v. Antiscalant pump stroke (0-100 percent)

(b) Chemical injection tubing and pump wetted parts shall be compatible with the antiscalant chemical in use on site.

(c) The chemical pumps, chemical tank and injection tubing shall be placed over the double containment bin such that any leaks will be collected in the double containment bin.

(7) Submit:

(a) A plan view layout and elevation drawings (all four sides) showing RO train membrane pressure vessel, piping headers and manifolds, instrumentation sampling/pipe tap points, and interfaces with piping. Show location of all instrumentation and power terminal junction boxes. Show all dimensions, parts, construction details, materials of construction, and bill-of-materials.

(b) Control Valve sizing calculations, piping materials, tubing and fittings.

c. New Pressure Filter

(1) Provide the following in the new Pressure Filter. Additional requirements to those listed below are listed in Specification 46 61 00, FILTRATION EQUIPMENT:

(a) Pressure vessel, media, piping and valves for feed, filtrate, backwash inlet, rinse and backwash outlet; sample valves, tubing, instrumentation, indicator panel, electrical and other items as specified herein and/or shown on drawing D-601 or Figure 7 in the attachment at the end of this section. The media filter shall have instrumentation and valve placement matching the existing media filters.

(b) All required components for a complete installation, including but not limited to, appropriate anchor bolts, piping supports, hardware, surface preparation, and shop and field painting.

(c) Pressure Vessel shall be equipped with necessary flanges and connections for the piping system. Vessel connections shall be located on the side of the filter tanks as shown in Figure 7 in the attachment at the end of this section.

(2) Indicator panel shall be NEMA 4X, 316 SS with indicator lights for the following to match existing shown in Figure 7 in the attachment at the end of this section:

(a) Each media filter unit motorized valve open or closed

(b) Each backwash pump, running or stopped

(c) Each pressure filter feed pump running or stopped

(3) Submit:

(a) Plan view layout and elevation drawings of the new media filter unit. Show all dimensions, parts, construction details, materials of construction, and bill-of-materials.

(b) Media information including manufacturer, model, uniformity coefficient and amount to be supplied.

d. Control Cabinet (CP3)

(1) Procure, assemble and supply a new NEMA 4X control cabinet to match the functionality of existing control cabinets CP1 and CP2 in the CUB (See Figures 9, 10 and 11 in the attachment at the end of this section). CP3 shall include at a minimum:

(a) PLC and/or PLC I/O to support the new equipment and integrate it into the existing control system. See section 3.6 below for Control Sequence Philosophy.

(b) Variable frequency drive for the new RO train feed pump. See specification SECTION 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.

(c) A power receptacle.

(d) Front panel shall include:

1. A touchscreen HMI-OIT similar to those on the CP1 and CP2. The HMI shall be programmed to have similar functionality as the HMIs on CP2 and CP3.

2. Control switch of manual or automatic operation of RO train 3.

3. Emergency stop push button

4. Indicator lights for RO train 3 running, and fault

(2) Submit:

(a) CP3 layout drawings and wiring diagrams. Show all dimensions, parts, construction details, materials of construction, and bill-of-materials.

(b) Design calculations prepared by a licensed professional structural engineer that certify that the RO train, media filter and CP3 shall meet the structural requirements conforming to Seismic Design Category B.

e. Valves

(1) Butterfly Valves

(a) Lug style butterfly valves for general service shall have cast iron or ductile iron bodies with integral cast top plate for direct flush-mounting of manual or power actuators; 316 stainless steel discs; 17-4 PH or 316 stainless steel one piece shafts; self-lubricating sleeve type bearings; EPDM replaceable

resilient seats; and self-adjusting packing. Valves shall be suitable for temperatures up to 120 degrees C and shall be bubble-tight at 12 bar differential pressure (sizes 50 mm to 300 mm) and 10 bar differential pressure (sizes 355 mm and larger). Valve body shall fit between ANSI 125 and 150 pound flanges.

(b) High Pressure (valves that can be exposed to pressures greater than 13.8 bar) Butterfly valves shall be high performance type rated for 40 bar cold water, nonshock, watertight shutoff and shall conform to the applicable requirements of ANSI/FCI 70-2. Valves shall be suitable for throttling operations and for very infrequent use after extended periods of inactivity. Bodies shall be Type 316 stainless steel, lugged, with drilling in accordance with ANSI B16.5, Class 300. One piece 316 stainless steel shaft laying length shall be manufacturer's standard. Bodies and discs shall be Type 316 stainless steel. Seals shall be V-type packing. O-rings, inverted packing gland or stuffing boxes are not acceptable. Valves shall have PTFE seats.

(2) Ball Valves

(a) PVC ball valves 50 mm and smaller shall be rated 10 bar at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem. Valves shall be of end entry, double union design, with solvent weld socket ends. Valves shall have replaceable EPDM seats and Viton or Teflon O ring stem seals. Valves shall have handle for manual operation.

(b) Stainless steel ball valves 100 mm and smaller shall have ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel bodies with Type 316 stainless steel balls. Valves shall be of the three-piece type with screwed ends, rated 1,000 pound WOG. Seat, body seal and stem packing shall be reinforced PTFE. Valves shall have lever operators.

(3) Sampling Valves

(a) Sample valves shall be PVC constructed with EPDM seals. The sample valves shall be 6 mm PVC Hayward Universal Stopcock ball valves or equal, male pipe thread by hose.

(4) Check Valves

(a) The Check valves in low pressure piping shall be line size ANSI Class 150 wafer type. Check valves shall be of the spring-assisted metal hinged design with 316 stainless steel bodies, dual 316 stainless steel plates, 316 stainless steel shafts and EPDM flat, full-contact seals. Seals shall be mechanically secured to the valve plates by means of 316 stainless steel clamp plates and fasteners to allow field replacement. The internal assembly shall be secured to the cast center post of the valve by means of 316 stainless steel fasteners.

(b) Check valves in high pressure piping (valves that can be exposed to pressures exceeding 13.8 bar) shall be ANSI Class 300 wafer type. Check valves shall be of the spring-assisted metal hinged design with 316 stainless steel bodies, dual 316 stainless steel plates, 316 stainless steel shafts and EPDM flat, full-contact seals. Seals shall be mechanically secured to the

valve plates by means of 316 stainless steel clamp plates and fasteners to allow field replacement. The internal assembly shall be secured to the cast center post of the valve by means of 316 stainless steel fasteners.

(c) For each pressure, Valve flow coefficient (Cv) values shall conform to the following:

Table 3 Check Valve Cv

Valve Size inches(mm)	Minimum Cv
376	160
102	230
153	800
203	1700
254	3000
305	4700
365	5950

(5) Pressure Relief Valves

(a) Pressure relief valves for lines with pressure less than 6 bar shall be direct acting diaphragm, spring controlled, in-line pattern, NPT threaded inlet and outlet, 10 bar design pressure. Valve shall have PVC body, Teflon or Viton diaphragm, PVC or Teflon piston, high-density polyethylene or stainless steel adjusting bolt and locknut, stainless steel or coated steel spring, stainless steel fasteners. Designed to open when upstream pressure reaches setpoint; set pressure adjustable from 0.7 to 6.5 bar, minimum.

(6) Flow Control Valves

(a) RO concentrate flow control valve shall be an ANSI class 300 globe valve with ASTM A276 GR 316 or ASTM A351/A351M GR CF8M body, bonnet, and disc. Gland shall be 316 SS. Gland packing and gasket shall be PTFE.

(7) Air Release Valves

(a) Air release valves are required on water pipelines at high points where air may be trapped.

(b) For stainless steel piping, valves shall:

1. Be rated for 20 bar working pressure, Type 316 Grade CF8M stainless steel body and cover with ASTM A240/A240M, 276 Type 316 stainless steel trim, float, and diffuser screen.

2. Automatically exhaust small amounts of air in systems under pressure. Float to seat against soft seat resilient material for positive closure. Valve to be outfitted with vacuum check device to prevent air re-entry into valve.

3. The air valves should be connected to a stainless steel type 316 ball valve via a stainless steel type 316 nipple, connected to the stainless steel pipe with a tee fitting via a stainless steel type 316 nipple. Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

(c) For thermoplastic piping, valves shall:

1. Be rated for 6 bar working pressure, all thermoplastic degassing valve, with size 1/2" Female NPT threaded system connection (for vertical orientation) and 1/8" Female NPT vent port. Seals will be EPDM. The internal float shall be constructed of polypropylene.

2. Automatic Degassing Valve is to continuously vent gases for a liquid-carrying pipeline or vessel. This float operated valve will open when liquid level falls (indicating the presence of gas) and closes when the gas has been evacuated as the liquid level rises.

f. Instruments

Gauges, sensors and similar products that are connected to stainless steel piping should be connected to a stainless steel type 316 ball valve via a stainless steel type 316 nipple, connected to the pipe with a tee fitting via a stainless steel type 316 nipple. Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

(1) Conductivity Analyzer and Transmitter

(a) Function: Continuously measure, indicate, and transmit a signal proportional to conductivity of a sample stream of noted process fluid.

(b) Performance

1. Accuracy: plus or minus 0.5 percent of reading.

2. Stability: plus or minus 0.25 percent of output range/month, non-cumulative.

3. Repeatability: plus or minus 0.25 percent of reading.

4. iv. Ambient Temperature Coefficient: plus or minus 0.01 percent of reading/degrees C.

5. Temperature Compensation: -15 to 200 degrees C (automatic or manual).

(c) Sensor Type

1. Style: Submersion/insertion screw-in.

(d) Transmitter

1. Output Signals: Linear, galvanically isolated 4-20 mA dc into 600 ohms maximum load.

2. Number of Outputs: 2.

3. Enclosure:
Type: NEMA 4X.
Mounting: Panel

(2) pH Analyzer and Transmitter

(a) Function: Continuously measure, indicate, and transmit a signal proportional to pH of a sample stream of noted process fluid.

(b) Performance

1. Full Scale Range: 0 - 14 pH.

(c) Sensor

1. Style: Insertion flow through

2. Conductivity Limit: 10 uS, minimum.

3. Wetted materials compatible with the process fluid

(d) Transmitter

1. Output Signals: Linear, galvanically isolated 4-20 mA dc into 600 ohms maximum load.

2. Number of Outputs: 2.

3. Temperature Compensation: Compensate glass impedance for better measurement accuracy. Allow tracking of processes with pH changes related to temperature using a programmable temperature coefficient of isopotential point.

4. Automatic Buffer Recognition: The control unit shall store buffer values and their associated temperature curves for common commercial buffer standards. The analyzer shall recognize any two of the three selected buffer values for the two point calibration and perform a self-stabilization check on the sensor in each buffer.

5. Enclosure:
Type: NEMA 4X.
Mounting: Panel

(3) ORP Analyzer and Transmitter

(a) Function: Measure and indicate locally the ORP and temperature of a continuous process sample stream.

(b) Performance

1. Accuracy: plus or minus 1.0mV.

2. Stability: plus or minus 1.0mV./month, non-cumulative.

3. Repeatability: plus or minus 1.0mV/degree C;

4. Temperature Coefficient: Input plus or minus 0.2mV/degree C, Output: plus or minus 0.4mV/degree C

5. Temperature Compensation: -15 to 120 degrees C

(c) Sensor

1. Style: Insertion flow through

2. Full Scale Range: -1400 to +1400mV.

3. Wetted materials compatible with the process fluid

(d) Transmitter

1. Output Signals: Linear, galvanically isolated 4-20mA dc into 600 ohms maximum load.

2. Number of Outputs: 2.

3. Temperature Compensation: Compensate glass impedance for better measurement accuracy. Allow tracking of processes with ORP changes related to temperature using a programmable temperature coefficient of isopotential point.

4. Automatic Buffer Recognition: The control unit shall store buffer values and their associated temperature curves for common commercial buffer standards. The analyzer shall recognize any two of the three selected buffer values for the two point calibration and perform a self-stabilization check on the sensor in each buffer.

5. Enclosure:
Type: NEMA 4X.
Mounting: Panel

(4) Magnetic Flow Element and Transmitter

(a) Function: Continuously measure, indicate, and transmit a signal proportional to the flow rate of a conductive process fluid in a full pipe.

(b) Performance

1. Accuracy: 0.5 percent of rate for all flows

2. Turndown Ratio: Minimum of 33 to 1 when flow velocity at minimum flow is at least 0.3 meters per second.

(c) Element

1. Flow Tube: Type 316 stainless steel.

2. Flanges: Type 316 stainless steel.

3. Flow Tube Liner: Teflon or PTFE.

4. Electrodes: Type 316 stainless steel.

(d) Transmitter

1. Outputs: Simultaneous analog and digital

2. Analog: 4 - 20 mA dc into 800 ohms, max.

3. Digital: Scaled pulse or frequency (selectable)

4. Enclosure Class: NEMA 4X epoxy coated cast aluminum.

5. Mounting: Integral or remote.

(5) Pressure Indicating Transmitter

(a) Function: Measure and locally indicate pressure and transmit signal proportional to pressure.

(b) Performance

1. Accuracy: Plus or minus 0.25 percent of span.

2. Select transmitter's factory upper range limit (URL) such that upper boundary of noted range is as close as possible to 80 percent of factory URL but does not exceed it.

(c) Features

1. Wetted Metallic Parts: Type 316 stainless steel.

2. Wetted O-Rings: Glass filled TFE, graphite filled PTFE, or Viton,

3. Bolts and Nuts (if required): Type 316 stainless steel.

4. Fill Fluid: Silicone.

5. Signal Interface:
4-20 mA dc output with digital signal

(d) Enclosure:

1. Type: NEMA 4X.

2. Materials: Coated aluminum.

(6) Differential Pressure Transmitter

(a) Function: Measure and locally indicate differential pressure

and transmit signal proportional to differential pressure.

(b) Performance

1. Accuracy: Plus or minus 0.25 percent of span.

(c) Features

1. Wetted Metallic Parts: Type 316 stainless steel.

2. Wetted O-Rings: Glass filled TFE, graphite filled PTFE, or Viton,

3. Bolts and Nuts (if required): Type 316 stainless steel.

4. Fill Fluid: Silicone.

5. Signal Interface:
4-20 mA dc output with digital signal

(d) Enclosure:

1. Type: NEMA 4X.

2. Materials: Coated aluminum.

(7) Pressure Gauge

(a) Function: Local pressure indication

(b) Gauges shall comply with ASME B40.100 Type 2A, as a minimum. Gauges shall have clear acrylic or shatterproof glass windows and shock-resistant cases. The design operations should be at the midpoint of the graduated scale. Major divisions shall be equally spaced and shall be in whole integers. Scale units shall be engraved on the scale face. Pointer travel shall not be less than 200 degrees nor more than 270 degrees arc.

(c) Performance:

1. Accuracy: Plus or minus 0.50 percent of full scale.

(d) Features

1. Pointer Vibration Reduction: Required.

2. Liquid filled gauge front.

3. Glycerin fill.

4. Case Material: Black thermoplastic

5. Materials of Wetted Parts:
Stainless steel, unless otherwise noted.

6. Pointer: Adjustable by removing ring and window.

g. All stainless steel piping shall be fully chemically passivated by immersion treatment, prior to electropolishing per ASTM B912.

Connections for pressure instrument taps shall be made via 6 mm FNPT SST weld-o-lets, located so as to ensure that the taps are above the location of the transmitters.

h. High pressure (6 bar or greater process stream pressure) feed, interstage, and final concentrate piping, shall be constructed of welded ASTM A312/A312M Type 316L stainless steel pipe.

i. Low pressure piping (below 6 bar maximum process stream pressure) shall be either ASTM A312/A312M Type 316L stainless steel for sizes larger than 200 mm diameter, or Schedule 80 ASTM D1785 PVC for sizes less than or equal to 200 mm diameter. Provide plastic pipe and fittings, bearing the seal of the National Sanitation Foundation (NSF) for potable water service from the same manufacturer.

j. Stainless steel butt welded type fittings shall be ASTM A403/A403M, Grade WP316L, Class W with schedule to match piping and dimensions in accordance with MSS SP-43 and ANSI B16.9. Forged stainless steel commercial welding branch fittings shall be ASTM A182/A182M, Grade 316L, with schedule to match connected piping. Forged stainless steel flanges shall be ASTM A182/A182M, Grade F316, lap joint flange with stainless steel stub end, ASTM A240/A240M, Type 316L, welded grade conforming to MSS SP-43, schedule to match pipe.

k. PVC pipe fittings shall be in compliance with ASTM D2467 (socket) and ASTM D2464 (threaded). PVC solvent cement shall be manufactured in conformance with ASTM D2564. Provide plastic pipe and fittings, bearing the seal of the National Sanitation Foundation (NSF) for potable water service from the same manufacturer.

l. Flanged joint bolts shall be 316 stainless steel ASTM A193/A193M, Grade B8M hex head bolts and ASTM A194/A194M, Grade 8M hex head nuts.

m. All high pressure tubing (6 bar or greater) shall be 316L stainless steel in accordance with ASTM A312/A312M, 0.065-inch wall, seamless, soft annealed. High pressure fittings shall be in accordance with ASTM A182/A182M. Low pressure tubing and fittings (less than 6 bar) shall be PVC or other suitable plastic manufactured by Imperial Eastman Division, Imperial Chevite, Inc., or equal.

n. The RO train feed and concentrate manifolds, as applicable, shall be connected to the pressure vessel ports with Type 316L stainless steel pipe spools or nipples, each using Victaulic-type connectors. These manifolds shall be designed with inlets/outlets for each pressure vessel. Any "unused" manifold ports shall be plugged with removable Type 316L stainless steel Victaulic caps.

o. Permeate manifolds, as applicable, shall be designed with inlets for each pressure vessel, and a permeate sample valve shall be supplied for every pressure vessel on this inlet prior to connection to the main permeate manifold. For each pressure vessel the permeate connector not used (opposite end from permeate header) shall be equipped with a quick disconnect and valve assembly designed to permit pressure vessel probing without substantial water leakage and without removing any piping or equipment.

p. Victaulic-type connectors shall be Type 316L stainless steel Victaulic Style 77 connectors with Type 316L stainless steel bolts, washers, and nuts, or equal.

q. All standard pipe support construction shall comply with standards developed by the Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS). Standard pipe support materials, design, and manufacture shall comply with ANSI/MSS SP-58 and ANSI/MSS SP-69 Pipe Hangers and Supports - Materials, Design, and Manufacture.

r. Provide feed and concentrate magnetic flow meters for the new RO train with meter manufacturer-recommended straight lengths of piping upstream and downstream of the meters and as specified herein.

s. Provide an instrument cabinet to provide local indication of process variables on the RO train. The instrument cabinet for the new RO train shall be similar to that of existing RO train 1, and shall include the ORP, conductivity and pH and transmitters.

t. The RO train permeate header shall be piped to an elevation above all pressure vessels in the train. Vacuum breakers shall be provided on the high elevation point of the RO train permeate header.

u. A pressure relief valve shall be provided on the RO train permeate header to protect the membrane system and piping. The pressure relief valve shall be designed to flow into well-secured PVC pipes discharging to the floor drain(s).

v. Framework:

(1) The new RO train frame shall be designed and constructed to support all loads, including, but not limited to, full-train quantity of membrane elements and pressure vessel, valves, piping when filled with water, and other items supported by the framework.

(2) Frames, racks, or skids that hold membrane assemblies, valves, piping, etc., shall be of welded steel and shall be designed to Seismic Design Category B.

w. Structural Steel:

(1) All steel plates and shapes shall be ASTM A36/A36M. The technique of steel welding employed, appearance, quality of welds made, and the methods of correcting defective work shall conform to codes for Arc and Gas Welding in Building Construction of the AWS and AISC. The strength of the welds shall meet or exceed the strength of the structural shape or tubing material. All welding operators shall be qualified in accordance with the current AWS requirements. Finished members shall be true to line and free from twists. Remove all weld spatter. Grind all welds smooth. Bolt holes, mounting holes, etc., shall be drilled prior to painting wherever possible.

(2) Thoroughly clean all ferrous metal items and give a shop coat of primer and finish coating system in accordance with Section 3.3 herein.

(3) Provide the membrane skid framework on concrete footpads in a similar fashion to the existing RO trains. Nonshrink grout shall be packed beneath the skid frame.

(4) All RO train piping shall be sized to keep flow velocities less than 3 meters per second.

2.2.1 Equipment Factory Testing

a. Certified test data shall be provided for the RO membrane elements and shall consist of the element serial number, the feed flow, recovery, productivity, rejection, and differential pressure.

b. Pressure Vessels

(1) Each vessel shall be tested at the manufacturer's facility for compliance with requirements set forth herein.

(2) A certified copy of the production test data for each pressure vessel shall be submitted prior to shipment.

2.2.2 Miscellaneous Components

a. Identification Tags: Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

b. Lifting Lugs: Equipment weighing over 100 pounds shall be provided with lifting lugs.

c. Anchor Bolts: Anchor bolts shall be Type 316L stainless steel and at least 50 mm in diameter. Coordinate required size with final Shop Drawings.

d. Spare Parts and Special Tools: Provide the following spare parts and special tools:

(1) One complete set of replacement cartridge filters and seals.

(2) Four each of pressure vessel seals, including feed/concentrate port seals, product water tube adapter seals, head seals, and permeate port seals.

(3) Spare components for pressure vessels including two product water tube adapters; two head retaining rings; two feed/concentrate port retaining rings; and one complete head assembly.

(4) One set of new and unused special tools required for installation, operation, and maintenance.

(5) All jigs, fixtures, clamps, lifting beams, hooks, and other apparatus shall be provided as part of the system as required to facilitate the complete removal, disassembly, renewal, assembly, and installation of each item of equipment within the system.

(6) Tools required for the membrane pressure vessels.

(7) One spare RO membrane element as listed above.

2.3 ELECTRICAL EQUIPMENT

2.3.1 Electrical Work

Electrical motor-driven equipment specified shall be provided complete with motors and motor starters and controls. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for the motor specified. Electrical work shall be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices shall be provided.

2.3.2 Electric Motors

Motors shall conform to NEMA MG 1. Motor with nameplates equal or greater than 380 watts shall be suitable for 400 volt, 3 phase operating service, unless otherwise specified. Motors of greater than 760 watts shall be high efficiency type as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3.3 Motor Controls

Controls shall conform to NEMA ICS 1.

2.3.4 Electrical Power Control

2.3.4.1 General Requirements

Provide and or supplement an automatic complete electrical power, control, and instrumentation system as specified or recommended by the equipment manufacturer for the safe operation and supervision of the new RO train and related equipment, except those items specified to be furnished under other sections. Schematics and interconnection wiring diagrams for power, control, and instrumentation circuits shall be provided to equipment specified. Terminal blocks (plus 25 percent spare terminals) shall be provided in CP3 to terminate field and interconnection wiring.

2.3.4.2 Control System

Provide control power transformers, relays, adjustable timers, auxiliary contacts, switches, or additional equipment as required to interconnect the new media filter unit and new RO train to the existing water treatment monitoring system, and control circuits. Conduit wiring between control panels and control devices shall be furnished as part of this specification.

Submit control, electrical and instrument information including the following items:

a. Product information for sensors/transducers and field instruments.

b. Programmable Controller System Information

(1) System Description

(2) Hardware Description

(3) Software Description

c. Panels, Consoles, and Cabinets Information

(1) Layout Drawings

(2) Panel schematic and internal point-to-point wiring interconnect and/or piping diagrams

(3) Electrical control schematics in accordance with NFPA standards for all circuits indicated in the specifications or on the Contract Drawings. No "typical" wiring diagrams will be acceptable and no tables or charts to describe wire numbers will be acceptable. Wires shall be labeled and shown on the submittal drawings.

(4) Plan showing equipment layout.

(5) Stock lists or Bill of Materials for each panel including tag number, functional name, manufacturer's name, manufacturer's model number, and quantity for components mounted in and on the panel, console, or cabinet.

d. Field wiring and piping diagrams and point-to-point wiring diagrams including interconnections between field devices, panels, control stations, lighting panels, and motor starters.

e. Instrument loop diagrams for analog display, control and I/O loops prepared using ISA standard symbols.

f. System Software Documentation shall include the following as a minimum:

(1) Complete hard copies of ladder diagram programming.

(2) Soft copy of the application programming and configuration.

(3) Complete listing of external and internal I/O address assignments, register assignments, and preset constant values along with functional point descriptions. Also list unused/undefined I/O and data table registers available.

(4) Complete hard copies of program documentation for all types of programs.

(5) Detailed system memory map defining memory segments used and spare memory segments available for system memory, I/O tables, Data Tables, and control program.

(6) Complete database listing.

(7) User's manual describing procedures and providing examples for use of programming terminal, accessories, and system utility routines to perform control, program modification, program verification, diagnostics, program documentation, loading and backup, and other required system support functions.

PART 3 EXECUTION

3.1 EXAMINATION

Verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

3.2 PREPARATION

3.2.1 Fabrication

The pressure filter and the RO train shall be factory assembled to the greatest extent possible to limit field work.

3.2.2 New Equipment Installation and Existing Equipment Shutdowns

The system shall be installed such that proper flow through the unit and required effluent conditions as specified herein will be achieved and maintained. Electrical work shall be in accordance with the applicable requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

The existing Water Treatment System at NSA II needs to remain operational during construction of the system expansion to the greatest extent possible. Shutdowns for movement of existing equipment (piping) and tie ins for the new equipment and controls shall be limited to a total of four shutdowns each less than or equal to eight hours in duration. The timing of the shutdowns needs to be coordinated with the government at least 48 hours before they are to occur.

3.3 PAINTING

Painting shall be performed in accordance with applicable requirements provided in Section 09 90 00 PAINTS AND COATINGS, and additional requirements provided herein.

3.3.1 Metal surfaces

Metal surfaces, except aluminum, bronze, brass, galvanized steel, and stainless steel shall be painted. Surface preparation and painting shall be performed in the shop or in the field as indicated. Manufactured items, such as motors and switchboards, shall be finished with the manufacturer's standard finish.

3.3.2 Preparation and Application

Ferrous metal surfaces shall be prepared in accordance with SSPC SP 6/NACE No.3 and painted with two or three coats of MIL-DTL-24441 epoxy paint to achieve a total dry film thickness of 150 microns. Master Painter's Institute (MPI) #120 Epoxy, High Build, Self-Priming, Low Gloss, is an acceptable replacement to MIL-DTL-24441.

3.3.3 Coating Testing

Coating shall be examined for flaws and tested for thickness. Thickness of coatings shall be measured wet and dry using a commercial film thickness gauge. The Contracting Officer shall be notified in advance of any painting. Additional coats shall not be applied until the previous coat has been approved. Repair or additional coats shall be accomplished at no additional cost to the government.

3.3.4 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, repair shall consist of preparing the affected area in compliance with SSPC SP 6/NACE No.3 and reapplying the coating to that area. If holidays are detected or film thickness is insufficient, the surface shall be prepared and additional coats applied in the affected area in compliance with the manufacturer's instructions.

3.4 SHIPMENT HANDLING AND STORAGE

Insofar as is practical, the equipment specified herein, shall be factory assembled. The parts and assemblies that are shipped unassembled, shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field. Generally, machined and unpainted ferrous metal parts shall be protected from the elements by the application of a strippable protective coating.

Weight, handling instructions, type of storage required, and instructions for protective maintenance during storage shall be included with each shipment to the project site.

The RO membrane elements and filter media shall be protected from direct sunlight and stored in a cool dry place with ambient temperature before loading. The RO membrane elements shall be loaded into the pressure vessels only after the trains (without membranes) are installed at the Site and have completed functional testing and subsequent disinfection. The membrane elements shall not be shipped to the site more than 1.5 months prior to loading into the pressure vessels.

3.5 INSTALLATION

3.5.1 Pressure Vessels

Anchor each vessel to the support frame with straps at three points. Install shims on the feed end of each vessel during loading of the membrane elements, to prevent movement of the elements within the pressure vessels.

3.5.2 Membrane Elements

Assemble elements for loading into each vessel in a row. Prior to loading, record the serial number of each element and its position within the pressure vessel.

Prior to loading elements, install the brine seals on the feed end of each element in the proper orientation. Install O-rings on the element interconnectors furnished by the membrane manufacturer.

Brine seals and O-rings shall be sparingly lubricated with a lubricant furnished or approved by the membrane manufacturer. Do not use excessive amounts of lubricant which may plug the elements.

Load elements into the pressure vessels from the feed end of each vessel. Loading or pushing elements in the opposite direction of feed/concentrate flow is not permitted.

3.5.3 Valves

Valves shall be erected and supported in their respective position free from distortion and strain on appurtenances during handling and installation. Material shall be inspected for defects in workmanship and material. Debris and foreign material shall be cleaned out of valve openings and seats; operating mechanisms shall be operated to check their proper functioning, and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced.

3.5.4 Piping

Piping shall be installed to accurate lines and grades. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Provision shall be made for expansion where necessary. Piping shall pitch toward low points, and provision shall be made for draining these low points. A sufficient number of unions or flanges shall be used to allow for the dismantling of all water pipe, valves, and equipment. Installation of piping including cleaning, cutting, threading and jointing, shall be in accordance with Section 22 00 00, PLUMBING GENERAL PURPOSE.

3.5.5 Installation Submittals

Submit field and installation information, including mounting requirements, sampling locations, access, approximate total weight of RO train, pressure media filter and CP3 and required conduit size and routing.

3.6 CONTROL SEQUENCE PHILOSOPHY CHANGES

The existing two RO trains each have their own control cabinets with PLCs. The new RO train and media filter PLC inputs and outputs will need to be incorporated into the existing controls seamlessly, without interruption of the operation of the existing water treatment system. It is recommended that the Contractor upload and save the existing PLC code. The existing code can be used as a baseline for new system additions, and a fall back in the event that any new code uploads are problematic.

Existing RO trains 1 and 2 each have Control cabinets (CP1 and CP2) that include both programmable logic controllers (PLCs) and human machine interfaces (HMIs). Improvements in the control logic as indicated below shall be incorporated into the PLCs and HMIs of the entire system. The Water Storage Tank Levels listed below are suggestions and shall be confirmed with the NSA II water treatment system operations staff on site.

3.6.1 RO Train Startup

a. Existing sequence: The existing scheme includes automatic RO train and supporting equipment (including filter feed pump, media filters, etc.) startup when water in the Product Water Storage Tank (also known as the groundwater storage tank) reaches a low level, unless the water level in the Raw Water Storage Tank is low.

b. Proposed scheme: - With the addition of a third RO train, two RO trains and associated equipment shall be initiated, with startup staggered by 2 minutes, when the Product Water Storage Tank reaches low level.

3.6.2 RO Train Cycling and Operation

Proposed scheme - Two RO trains should be in operation when the Product Water Storage Tank level is less than 75 percent. When the tank level exceeds 85 percent, one of the two RO trains (the one that has been in operation the longest), and supporting equipment, should shut down, leaving one RO Train operational. Subsequently, when the Product Water Storage Tank level decreases below 75 percent, a second RO train and supporting equipment should be initiated. RO train initiation should give priority to the RO train that has been idle the longest.

The control system should be configured to allow operation of all three RO trains simultaneously. However, this is to be an operator initiated sequence, and shall not be initiated automatically by the control system.

3.6.3 RO Train Shutdown

All operating RO trains and supporting equipment shall be shut down in the event that the Product Water Storage Tank reaches a level of 95 percent.

3.7 FIELD TESTING AND COMMISSIONING

a. In addition to what is listed below, adhere to the following provisions of 01 91 00.15 TOTAL BUILDING COMMISSIONING:

(1) Section 1.4 Communication

(2) Section 1.6 Submittals

(3) Section 3.1.5.5.1 Functional Performance Tests

b. Field Testing and Commissioning Plan

(1) Develop detailed startup procedures and timetable to include new media filter and RO train installation, testing, disinfection, media membrane loading and flushing, and testing.

(2) Develop and submit a written plan that includes step-by-step instructions for field testing and commissioning to include test procedures and recording forms that document the results for approval to the Contracting Officer 21 calendar days prior to the proposed test date. Ensure procedures clearly state step by step instruction to verify system parameters, components, and functions.

c. Field Testing and Commissioning Meetings

(1) Schedule Unit Process Functional and Facility Performance Demonstration meetings as required to discuss the test schedule, test methods, materials, chemicals and liquids required, facilities operations interfaces, and Government involvement

d. Water Quality and Analysis

(1) Provide the services of, and bear all costs associated with, an independent, third-party laboratory certified for drinking water analyses.

e. All major system components shall be factory tested insofar as practicable for compliance with the construction and functional

requirements specified herein, and a certification of the results of these tests shall be submitted to the Government.

f. Prior to system startup, all system components shall be inspected for proper alignment, proper noise levels, proper connection, and satisfactory performance. The manufacturer's representative for all system components shall provide written certification to the Engineer and Government that furnished equipment has been installed in accordance with the approved method and is ready for permanent operation.

g. Responsibilities

(1) Contractor Testing and Startup Responsibilities

(a) Perform all work for functional and performance tests specified.

(b) Provide all equipment, materials, and labor to inspect, check-out, start-up and test equipment and systems.

(c) Demonstrate proper function of all equipment, systems, and control devices.

(d) Complete all work associated with the pressure filter and RO train and related processes before testing, including related manufacturer's representative services.

(e) Provide all related operating and maintenance manuals, spare parts and special tools as specified before testing any unit or system.

(f) Furnish qualified manufacturer's representatives when required to assist in testing.

(g) Schedule and attend pretest (functional and performance) meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, and Government involvement.

(h) Provide equipment necessary to divert testing water to disposal or recirculation.

(i) Designate and provide one or more persons to be responsible for coordinating and expediting Contractor's testing and startup duties. The person or persons shall be present during all testing and startup meetings and shall be available at all times during the startup period.

(2) Government Responsibilities During Testing

(a) General:

1. Review Contractor's test plan and schedule.

2. Witness each functional or performance test

3. Coordinate other plant operations, if necessary, to facilitate Contractor's tests.

4. Provide water for functional/performance testing.

5. Startup Test Period/14-Day Demonstration Test:

- Develop startup schedule and plan in cooperation with Contractor.

- Provide all chemicals as required for testing, unless otherwise indicated.

- Support the Contractor in operating new process units and devices.

- Provide sampling labor and materials as required.

- Make available spare parts and special tools and operation and maintenance information for existing equipment.

h. Functional Testing:

(1) Prior to the functional test, the Contractor is to perform an Operational Readiness Test (ORT) on the new equipment and control system. The ORT shall verify signal integrity calibration of instruments, proper display of process variables on HMI and proper operation of control valves, variable speed feed pumps, and other equipment related to the water treatment system.

(2) During the functional test, it is recommended that:

(a) Feed water to the new RO train be passed through the new media filter unit.

(b) RO permeate and concentrate from the new RO train each be recycled back to the raw water storage tank by Contractor supplied temporary piping.

These streams should be directed back to the tank prior to any post treatment chemical addition. Once the functional testing is complete, the new RO train will need to be disinfected. During the disinfection, and during the subsequent RO membrane addition and RO membrane supplier recommended flushing, both the permeate and the concentrate from the new RO train will be plumbed to off-site disposal or to the sewer. Again, the Contractor shall provide any temporary piping necessary.

(3) Functional testing will be performed with orifice plugs in the pressure vessel permeate end caps and blind plugs in the opposite end caps. Contractor to furnish, install and remove all orifice and blind plugs used for testing. Permeate orifice plugs shall be sized to simulate the hydraulic design of the membranes.

(4) Functional testing includes hydraulic, electrical, and instrumentation control system checks to verify that the entire water treatment system, including the new equipment, will startup, operate, and shut down properly. This testing includes verification of all emergency and alarm conditions. Documentation in the form of detailed check-off sheets shall be submitted at the conclusion of the successful functional test. Functional tests and

documentation shall be coordinated with other testing of related equipment and facilities to ensure proper operation of the complete integrated system.

(5) Membrane System Functional Tests shall include:

(a) New media filter unit and RO train testing including at least two startups and two shutdowns, to demonstrate the correct adjustment and performance of all system components (without membranes installed but with RO feed pump).

(b) New media filter unit and RO train running simultaneously for 48 hours, including at least one sequenced RO train startup, one sequenced RO train shutdown, one new media filter unit backwash, and simultaneous shutdown (simulating loss of power supply during emergency conditions).

(c) The major acceptance criteria for the 48-hour functional test shall be that the new pressure filter and RO train, operate as intended without major mechanical or electrical problems and with minimal operator attention. Observed deficiencies in operation of furnished Work shall be corrected to the satisfaction of the Government at no cost to the Government.

(6) Following successful completion of the 48-hour functional test, disinfect the new RO train and associated piping per AWWA C653-13.

(a) After the disinfection procedure is completed, the super chlorinated water used for the disinfection process shall be neutralized and disposed properly.

(b) After the disinfection procedure is completed, two or more samples shall be taken not less than 30 min apart and shall be tested for the presence of coliform in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater. If none of the samples show the presence of coliform, the new equipment may be placed in service.

(7) Following disinfection and subsequent rinsing of the system, load RO membranes in the new RO train. Subsequently flush the membrane preservative to waste per the RO manufacturer's instructions.

i. Performance Demonstration Testing:

(1) Conduct a 14-day performance demonstration test on the new pressure filter unit and RO train to demonstrate their competent operation in accordance with the intent of these Contract Documents.

(2) Submit proposed diagrams, instructions, and other sheets, prior to posting. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the

diagrams. The framed instructions shall be posted before acceptance testing of the systems.

(3) Performance testing includes testing the new pressure filter unit and the new RO train with membranes installed in the normal operating mode to verify conformance with the performance aspects of this Specification. Performance testing shall not commence until all functional tests have been completed and approved by the Government and Contractor, and also a detailed performance testing plan has been approved by the Government and Contractor. Furthermore, membrane elements shall not be installed until after all chlorinated water used for disinfection has been flushed from the systems.

(4) After the plant is operating, but prior to initiation of the 14-Day Demonstration Test, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to plant startup. This shall include verification of proper membrane element installation by conducting a conductivity profile and vessel probing for each pressure vessel of the reverse osmosis train while the train is operating.

(a) Contractor personnel shall conduct the profiles by sampling permeate from the sample valves on each pressure vessel within the new RO train.

(b) Those vessels not meeting pre-established conductivity criteria shall be opened up by the Contractor and examined for proper installation of end connectors and element interconnectors, damaged O-rings, misaligned brine seals, and other like causes.

(c) Any observed deficiencies shall be corrected by the Contractor.

(5) Testing

(a) The test shall be considered complete when, in the opinion of the Government, the new media filter unit and RO train have operated in the manner intended at plant design capacity for 14 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere. A significant interruption will require the test then in progress to be stopped and restarted after corrections are made.

1. Significant Interruption: May include any of the following events:

- Failure of Contractor to maintain qualified onsite startup personnel as scheduled

- Failure of any equipment item or treatment subsystem furnished by Contractor to meet specified performance requirements for more than 2 consecutive hours.

- Failure of any equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.

- Failure of any non-critical equipment or unit process

that is not satisfactorily corrected and retested with Government witnessing within eight (8) hours after failure.

- As determined by the Government's representative.

(b) Minimum prerequisites prior to initiation of the 14-Day Demonstration Test include the following:

1. Successful completion of 48-hour functional test.

2. Completion of membrane element loading and checkout for the reverse osmosis train.

(c) Final Acceptance: Government will accept the membrane system as complete and ready for continuous operation only after successful testing and startup is completed and documented, test and startup reports submitted, and manufacturers' services completed for training of Government's personnel. The major acceptance criteria shall be as follows:

1. The new media filter unit shall produce a minimum of 800 lpm and the new RO train shall each produce a minimum of 624 lpm of RO permeate at 75 to 80 percent recovery. During the acceptance test the new media filter unit filtrate and new RO train permeate quality shall comply with the requirements herein. The Contractor shall have a qualified laboratory, approved by the Government, analyze water quality not being conducted onsite. Per CNIC M-5090.1, suggested laboratories shall either be U.S. Army Public Health Center (PHC) laboratories or laboratories accredited to ISO/IEC 17025 by International Laboratory Accreditation Cooperation (ILAC) Signatories if a PHC lab cannot be identified.

- 4 RO feed and RO permeate samples (new RO train)shall be collected. Samples shall be taken not less than 24 hours nor more than 120 hours apart. Samples shall be analyzed for the constituents in Table 2.

2. In addition, it will be expected that the plant will operate as intended without major mechanical or electrical problems and with minimal operator attention.

(d) Report: At the end of the 14-day test, prepare a test report which shall include daily operating and normalized (new RO train) performance data for each day of the test. The report shall also include water analysis results of the feed water, new media filter filtrate, new RO train permeate, and new RO train concentrate. The data taken during the testing period shall be presented in graphical and tabular forms. The report shall also have a summary of the analyses stating if the systems meet the requirements as specified.

(e) In the case of a nonconforming system, the Government may at its option, withhold final payment to the Contractor until the system is reclassified as conforming.

3.8 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period

of 84 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Field training shall cover all of the items contained in the Operating and Maintenance Instructions. The instructions shall include, but shall not be limited to the following:

a. System layout showing piping, valves and controls and installation requirements.

b. Approved wiring, logic, and control diagrams prepared in accordance with ANSI/ISA 5.1 including a drawing index, legend and symbols list, and abbreviations and identifiers.

c. A control sequence describing startup, operation, and shutdown; including the functional and operational description of the control system covering the procedures for programming, operation, startup, shut-down, and calibration.

d. Operating and maintenance instructions for each piece of equipment, including checkout, troubleshooting, and servicing. Specific instructions for individual pressure vessel permeate probing shall be provided and a demonstration of this specific procedure shall be conducted.

e. Manufacturer's bulletins, cut sheets and descriptive data, parts list, and recommended spare parts.

3.9 CLOSE OUT SUBMITTALS

As-Built Drawings

Final as-built drawings.

Certification by an independent third-party organization that all interior coating and materials that come in contact with the brackish or potable water comply with NSF/ANSI 61.

System Pressure and leak test

Test results from commercial laboratory verifying system disinfection.

-- End of Section --

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SECTION 01 80 10 Exhibit

Figure 1 - RO Train 1, Left Front Side

Figure 2 - RO Train 1, Right Front Side

Figure 3 - RO Trains 1 and 2, Front Side

Figure 4 - RO Trains 1 and 2 (Rear Side of Train 1)

Figure 5 - RO Train 1 Rear Side

Figure 6 - Inside RO Train 1 Instrument Cabinet

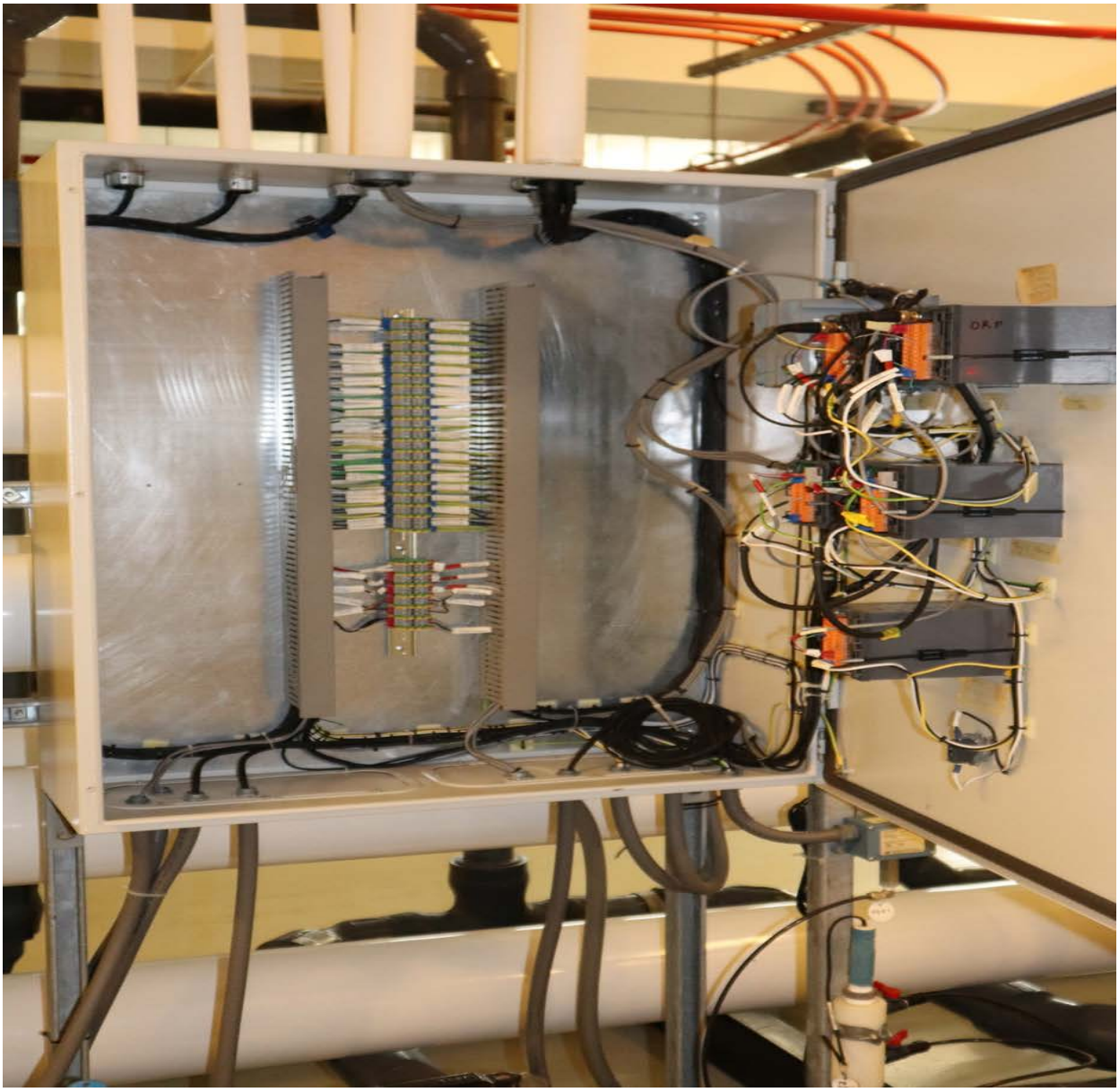

Figure 7 - Pressure Filter Unit 2 and Control Panel

Figure 8 - Space for Pressure Filter 3

Figure 9 - Control Panel 2, Left Side, PLC, HMI, etc.

Figure 10 - Control Panel 2, Right Side, RO Feed Pump VFD, etc.

Figure 11 - Control Panel 3

SECTION 01 91 00.15

TOTAL BUILDING COMMISSIONING
02/19

PART 1 GENERAL

1.1 SUMMARY

Commission the building systems listed herein. Employ the services of an independent Commissioning Firm. The Commissioning Firm must be a 1st tier subcontractor of the General or Prime Contractor and must be financially and corporately independent of all other subcontractors. The Commissioning Firm must employ a Lead Commissioning Specialist that coordinates all aspects of the commissioning process. Conform to the commissioning procedures outlined in this specification.

1.2 SYSTEMS TO BE COMMISSIONED

Commission the following systems:

Heating, Ventilating, Air Conditioning, and Refrigeration Systems (HVAC)

Building Automation System

Fire Suppression and Alarm Systems

Power Distribution Systems

Plumbing Systems

Energy and Water Utility Metering Systems and Sub-Meters

Water Treatment System - Refer to Specification Section 01 80 10 SUMMARY OF WORK FOR P964 WATER TREATMENT EQUIPMENT EXPANSION

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 202	(2013; Addenda B 2018) Commissioning Process for Buildings and Systems

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline	(2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard	(2009) Procedural Standards for Whole Building Systems Commissioning of New

Construction; 3rd Edition

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1429 (1994) HVAC Systems Commissioning Manual, 1st Edition

1.4 COMMUNICATION WITH THE GOVERNMENT

The Lead Commissioning Specialist (CxC) must submit all required submittals to the Government via the prime contractor. The Lead Commissioning Specialist must have direct communication with the Contracting Officer's Technical Representative regarding all elements of the commissioning process; however, the Government has no direct contract authority with the Lead Commissioning Specialist.

1.5 SEQUENCING AND SCHEDULING

1.5.1 Sequencing

Complete the following prior to starting Functional Performance Tests of mechanical and plumbing systems:

a. All equipment and systems have been completed, cleaned, flushed, disinfected, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications.

b. Performance Verification Tests of the controls systems have been completed and the Performance Verification Test Report has been submitted and approved in accordance with Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

c. Testing, Adjusting, and Balancing has been completed and the Testing, Adjusting, and Balancing Report, and all TAB and DALT related submittals prerequisite to the TAB Report, have been submitted and approved in accordance with Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

d. The building envelope is enclosed according to contract documents with final construction completed.

e. The Pre-Functional Checklists have been submitted and approved.

f. The Certificate of Readiness for mechanical and plumbing systems has been submitted and approved.

Complete the following prior to starting Functional Performance Tests of the electrical systems:

a. All electrical, power generation, and lighting equipment and systems have been completed, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications.

b. The building envelope is enclosed according to contract documents with final construction completed.

c. Ceiling tiles, floor coverings, and window coverings are in place.

d. The Certificate of Readiness for electrical systems has been submitted and approved.

1.5.2 Project Schedule

Include the following tasks in the project schedule required by Section 01 32 17.12 10 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS). Ensure sufficient time is scheduled to accommodate the requirements of this specification section. The order of items listed below is not intended to imply a specified sequence:

a. Submission and approval of the Commissioning Firm and Commissioning Specialist

b. Submission and approval of the Testing, Adjusting, and Balancing (TAB) Firm and TAB Specialist specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

c. Submission of the Design Review Report specified herein.

d. Submission of the Design Review Report specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

e. Submission and approval of the Construction Phase Commissioning Plan

f. Installation of permanent utilities (gas, water, electric)

g. Air Barrier Pressure Tests specified in Specification Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM

h. Drainage and Vent, Building Sewers, Water Supply Systems and Backflow Prevention Assembly Tests specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE

i. Factory Acceptance Testing for each of the systems to be commissioned as required by technical specifications

j. Manufacturer's Equipment Start-Up for each of the systems to be commissioned.

k. Potable Water System Flushing specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE

l. Operational Tests of the plumbing system specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE.

m. Potable Water System Disinfection specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE

n. Submission and approval of the TAB Schematic Drawings, Report Forms, and Procedures specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

o. Testing, Adjusting, and Balancing (TAB) Field Work required by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

p. Submission and approval of the TAB Report specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

q. TAB Field Acceptance Testing required by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

r. Submission and approval of the Start-Up Testing Report specified in Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

s. Submission and approval of the Performance Verification Test Procedures specified in Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

t. Performance Verification Tests required by Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

u. Performance Verification Test Report specified in Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

v. Pre-Functional Checklist Submittal

w. Functional Performance Testing for each system to be commissioned

x. Post-Test Deficiency Correction for each system to be commissioned

y. Re-Testing

z. Training for each of the systems to be commissioned

aa. Systems Manual

bb. Submission and approval of the Commissioning Report

cc. Seasonal Testing

dd. Post-Construction Site Visit

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Commissioning Firm; G M/R

Lead Commissioning Specialist; G M/R

Technical Commissioning Specialists; G M/R

Commissioning Firm's Contract; G M/R

SD-06 Test Reports

Design Review Report; G M

Interim Construction Phase Commissioning Plan; G M

Final Construction Phase Commissioning Plan; G M

Pre-Functional Checklists; G M

Issues Log; G M

Commissioning Report; G M

SD-07 Certificates

Certificate of Readiness

SD-10 Operation and Maintenance Data

Training Plan; G R

Training Attendance Rosters; G R

Systems Manual; G R

SD-11 Closeout Submittals

Final Commissioning Report; G M/R

1.7 COMMISSIONING FIRM

Provide a Commissioning Firm that is certified in commissioning by one of the following: the AABC Commissioning Group (ACG); the National Environmental Balancing Bureau (NEBB); the International Certification Board/Testing, Adjusting, and Balancing Bureau (ICB/TABB), the Building Commissioning Association (BCA); the Association of Energy Engineers (AEE). The Commissioning Firm must be certified in all systems to be commissioned to the extent such certifications are available from the certifying body. Describe any lapses in certification or disciplinary action taken by the certifying body against the proposed Commissioning Firm or Lead Commissioning Specialist in detail. Any firm or commissioning professional that has been the subject of disciplinary action by the certifying body within the five years preceding contract award is not eligible to perform any duties related to commissioning.

a. Submit the Commissioning Firm's certification of qualifications including the name of the firm and certifications no later than 60 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

b. The Commissioning Firm's and Commissioning Specialists' certifications must be maintained for the entire duration of the duties specified herein. If, for any reason, the firm or a specialist loses a certification during this period, immediately notify the Contracting Officer's Technical Representative and submit another Commissioning Firm or Commissioning Specialist for approval. All work specified in this specification section performed by the Commissioning Firm or associated Commissioning Specialists is invalid if the Commissioning Firm or Commissioning Specialist loses its certification prior to contract completion and must be performed by an approved successor.

c. The Commissioning Firm must oversee and assist the General or Prime Contractor with the work specified herein. Submit the Commissioning Firm's Contract including the Scope of Work associated with the

paragraph POST-CONSTRUCTION SUPPORT no later than 30 calendar days after approval of the Commissioning Firm. Submit one hard copy and an electronic copy.

1.7.1 Lead Commissioning Specialist

The Commissioning Firm must provide a Lead Commissioning Specialist (CxC) that has a minimum of five years of commissioning experience, including two projects of similar size and complexity, and that is one of the following: a NEBB qualified Systems Commissioning Administrator (SCA); ACG Certified Commissioning Authority (CxA); ICB/TABB Certified Commissioning Supervisor; BCA Certified Commissioning Professional (CCP); AEE Certified Building Commissioning Professional (CBCP); University of Wisconsin-Madison Qualified Commissioning Process Provider (QCxP); ASHRAE Commissioning Process Management Professional (CPMP).

a. Submit the Lead Commissioning Specialist's certification of qualifications including the name of the specialist and firm; certifications; years of experience; and a listing of representative projects of similar size and complexity no later than 30 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

b. The Lead Commissioning Specialists certifications must be maintained for the entire duration of the duties specified herein. If, for any reason, the specialist loses a certification during this period, immediately notify the Contracting Officer's Technical Representative and submit another Lead Commissioning Specialist for approval. All work specified in this specification section to be performed by the Lead Commissioning Specialist is invalid if the Lead Commissioning Specialist loses its certification prior to contract completion and must be performed by an approved successor.

c. The Lead Commissioning Specialist must lead and oversee the commissioning work specified herein and be the primary point of contact for the Government regarding the commissioning work. One of the Technical Commissioning Specialists may be the Lead Commissioning Specialist provided that all of the qualification requirements are met.

1.7.2 Technical Commissioning Specialists

Technical Commissioning Specialists, employed by the Commissioning Firm and that have the following qualifications, must perform the technical work specified herein associated with each system to be commissioned:

a. Mechanical Technical Commissioning Specialist: The technical work associated with mechanical systems including Heating, Ventilating, Air Conditioning, and Refrigeration Systems; Building Automation System; Plumbing Systems; Water Pumping and Mixing Systems; Energy and Water Utility Metering Systems; Electrical Distribution Systems must be performed by a Commissioning Specialist certified by NEBB, ACG, ICB/TABB, AEE, University of Wisconsin-Madison, ASHRAE, or BCA in the commissioning of HVAC systems with five years of experience in the commissioning of HVAC systems.

b. Submit the Technical Commissioning Specialist's certification of qualifications including the name of the specialist and firm; certifications; years of experience; and a listing of representative projects of similar size and complexity no later than 30 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

1.7.3 Commissioning Standard

Comply with the requirements of the commissioning standard under which the Commissioning Firm and Specialists qualifications are approved. When the firm and specialists are certified by BCA, AEE, ASHRAE, or the University of Wisconsin-Madison, comply with the requirements of one of the acceptable standards unless otherwise stated herein. The acceptable standards are ACG Commissioning Guideline, NEBB Commissioning Standard, SMACNA 1429, or ASHRAE 202. Comply with applicable NETA testing standards for electrical systems.

a. Implement all recommendations and suggested practices contained in the Commissioning Standard and electrical test standards.

b. Use the Commissioning Standard for all aspects of Commissioning, including calibration of instruments.

c. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, adhere to the manufacturer calibration recommendations.

d. All quality assurance provisions of the Commissioning Standard such as performance guarantees are part of this contract.

e. The Commissioning Specialists must develop commissioning procedures for any systems or system components not covered in the Commissioning Standard.

f. Use any new requirements, recommendations, and procedures published or adopted prior to contract solicitation by the body responsible for the Commissioning Standard.

1.8 ISSUES LOG

The Lead Commissioning Specialist must develop and maintain an Issues Log for tracking and resolution of all deficiencies discovered through submittal reviews, inspection, and testing. Include the date of final resolution of issues as confirmed by the Commissioning Specialist. Submit the Issues Log to the Contracting Officer's Technical Representative on a monthly basis at a minimum. At any point during construction, any commissioning team member finding deficiencies may communicate those deficiencies in writing to the Commissioning Specialist for inclusion into the Issues Log.

Track construction deficiencies identified in the Issues Log in accordance with the Quality Control Plan required by Specification Section 01 45 00.00 20 QUALITY CONTROL.

1.9 CERTIFICATE OF READINESS

Prior to scheduling Functional Performance Tests for each system, issue a Certificate of Readiness for the system certifying that the system is ready for Functional Performance Testing. The Certificate of Readiness must include, for each system to be commissioned, all equipment and system start-up reports; Performance Verification Test Reports; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; HVAC Controls Start-Up Reports; and the Air Leakage Test Reports and Diagnostic Test Reports to the extent applicable to the system. The

Contractor; the Lead Commissioning Specialist; the Contractor's Quality Control Representative; the Mechanical, Electrical, Controls, and TAB subcontractor representatives must sign and date the Certificate of Readiness. Submit the Certificate of Readiness for each system no later than 14 calendar days prior to Functional Performance Tests of that system. Submit one hard copy and an electronic copy. Do not schedule Functional Performance Tests for a system until the Certificate of Readiness for that system receives approval by the Government.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 CONSTRUCTION PHASE

3.1.1 Construction Commissioning Coordination Meeting

The Lead Commissioning Specialist must lead a Construction Commissioning Coordination Meeting no later than 14 days after approval of the Commissioning Firm and Commissioning Specialists to discuss the commissioning process including contract requirements, lines of communication, roles and responsibilities, schedules, documentation requirements, inspection and test procedures, and logistics as specified in this specification section. The Contractor's Superintendent or Project Manager, the Contractor's Quality Control Representative, and the Government must attend this meeting. Invite the User and a Public Works Division Representative to attend this meeting.

3.1.2 Construction Phase Commissioning Plan

3.1.2.1 Interim Construction Phase Commissioning Plan

The Lead Commissioning Specialist (CxC) must prepare the Interim Construction Phase Commissioning Plan. Submit the Interim Construction Phase Commissioning Plan no later than 30 calendar days after the Construction Commissioning Coordination Meeting and no later than 14 days prior to the start of construction of the building envelope. Submit one hard copy and an electronic copy.

Identify the commissioning and testing standards and outline the overall commissioning process, the commissioning schedule, the commissioning team members and responsibilities, lines of communication, documentation requirements for the construction phase of the project in the Interim Construction Phase Commissioning Plan.

3.1.2.1.1 Checklists

Download example Pre-Functional Checklists and Functional Performance Test Checklists for specification section 01 91 00.15 TOTAL BUILDING COMMISSIONING at the following location:
http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic
The checklists submitted in the Interim and Final Construction Phase Commissioning Plans must contain the same level of detail shown in the examples. The submitted checklists are not required to match the format of the examples.

3.1.2.1.2 Contents

In addition, include the following in the Interim Construction Phase Commissioning Plan:

a. Plan purpose

b. Commissioning scope

c. Systems to be commissioned

d. Examples and description of development of pre-functional and functional performance test checklists

e. Building information

f. Contact information for the Commissioning Specialists, the Contracting Officer's Technical Representative, and the Commissioning Team listed in paragraph Commissioning Team

g. Roles and responsibilities

h. Management plan

i. Owner's Project Requirements Document

j. Basis of Design

k. Description of design reviews by the Commissioning Specialists

l. Description and templates for site observation reports and the issues log

m. Listing and description of required meetings

n. Identification and sequence of commissioning and acceptance tasks for incorporation into the Project Schedule

o. Listing of required submittals to Government and Commissioning Specialists

p. Description of execution of pre-functional checks and functional performance tests

q. Operation and maintenance manual requirements

r. Description of training requirements

s. Description of required Systems Manual

t. Description of the Commissioning Report

3.1.2.2 Final Construction Phase Commissioning Plan

The Lead Commissioning Specialist (CxC) must prepare the Final Construction Phase Commissioning Plan. Submit the Final Construction Phase Commissioning Plan no later than 30 calendar days prior to the start of Pre-Functional Checks. Submit one hard copy and an electronic copy.

Include the information provided in the Interim Construction Phase Commissioning Plan. In addition, the Technical Commissioning Specialist must develop the Pre-Functional Checklists and Functional Performance Test Checklists for each building, for each system required to be commissioned, and for each component for inclusion in the Final Construction Phase Commissioning Plan.

3.1.2.2.1 Pre-Functional Checklists

The Pre-Functional Checklists must include items for physical inspection or testing that demonstrate that installation and start-up of equipment and systems is complete. Refer to paragraph Pre-Functional Checks for more information.

3.1.2.2.2 Functional Performance Test Checklists

Functional Performance Test Checklists must include procedures that explain, step-by-step, the actions and expected results that will demonstrate that the system performs in accordance with the contract. Refer to paragraph Functional Performance Tests for more information. Include the following sections and details appropriate to the systems being tested in the Functional Performance Test Checklists:

a. Notable system features including information about such attributes as system sizing and controls to facilitate understanding of system operation

b. Conclusions and recommendations based on control system feature, point-to-point, actuator, and system operation observations. Conclusions must clearly indicate if system does or does not perform in accordance with contract requirements. Recommendation must clearly indicate that the system should or should not be accepted by the Government.

c. Test conditions including date, beginning and ending time, and beginning and ending outdoor air conditions

d. Attendees present throughout the entire system test

e. Identification of the equipment involved in the test

f. Control system feature identification including control point description, embedded/visible type, adjustable/monitoring type, actual value, and setpoint value/alarm range

g. Point-to-point observations including demonstrating system flow meters and sensors have been calibrated and are correctly displayed on the Operator work station

h. Actuator operation observations demonstrating actuator responses to commands from the control system

i. System operation observations for system-based tests demonstrating each control algorithm, operation mode, and alarm condition resulting from control point(s) manipulation. System operation observations must contain the following:

(1) introduction identifying testing methodology

(2) as-found conditions prior to control point(s) manipulation

(3) clear list of test items (step numbers)

(4) control algorithm (design control sequence) segmented by unique functions

(5) intended test procedures following each segmented control algorithm identifying control point(s) required to be manipulated to initiate system response

(6) expected system response

(7) space for comments for each test item complete including resulting control signal such as 0-volts, 10-volts, active, or inactive

(8) pass or fail indication for each test item

3.1.3 Design Review

The Lead Commissioning Specialist and Technical Commissioning Specialists must review the construction contract plans and specifications, the Owner's Project Requirements Document, and the Basis of Design. The Owner's Project Requirements Document is attached as Appendix A. The Basis of Design is attached as Appendix B. The Owner's Project Requirements Document and Basis of Design documents are not contract documents and are provided for commissioning review purposes only.

a. Advise the Contracting Officer's Technical Representative of any discrepancies between the Basis of Design and Owner's Project Requirements, deficiencies of the design to comply with the Owner's Project Requirements or Basis of Design, and deficiencies that would prevent the building systems and features from operating or performing effectively and from being adequately maintainable.

b. The Commissioning Specialists must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation or performance. Submit one hard copy and an electronic copy of the report to the Contracting Officer's Technical Representative no later than 14 days after approval of the Commissioning Specialists.

c. The Lead Commissioning Specialist must participate in a meeting to discuss any items contained in the report no later than 14 calendar days after submission of the report.

3.1.4 Construction Submittals

Provide all submittals associated with the systems to be commissioned, including shop drawings; equipment submittals; test plans, procedures, and reports; and resubmittal's to the Commissioning Specialists. The Technical Commissioning Specialist must review the submittals to the extent necessary to verify that the equipment and system installation will comply with the contract requirements and the requirements of the Basis of Design and the Owner's Project Requirements Document.

3.1.5 Inspection and Testing

Demonstrate that all system components have been installed, that each

control device and item of equipment operates, and that the systems operate and perform, including interactive operation between systems, in accordance with contract documents and the Owner's Project Requirements. Requirements in related specification sections are independent from the requirements of this section and do not satisfy any of the requirements specified in this specification section. Provide all materials, services, and labor required to perform the Pre-Functional Checks and Functional Performance Tests.

3.1.5.1 Commissioning Team

Provide a commissioning representative for each sub-contractor associated with the systems to be commissioned. Each commissioning representative is responsible for coordination of their respective sub-contractor's execution of the commissioning activities and participation in the inspection and testing required by this specification section. The designers listed below are the designers of record for their respective systems. Substitutes must be approved by the Contracting Officer's Technical Representative.

3.1.5.1.1 Mechanical and Plumbing Systems Pre-Functional Checks Team

The following team members must participate in Pre-Functional checks of mechanical systems:

Designation	Function
CxM	Mechanical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
MC	Contractor's Mechanical Commissioning Representative
FC	Contractor's Fire Suppression and Alarm Commissioning Representative
CC	Contractor's Controls Commissioning Representative
TABC	Contractor's TAB Commissioning Representative
PC	Contractor's Plumbing Commissioning Representative

3.1.5.1.2 Electrical System Pre-Functional Checks Team

The following team members must participate in Pre-Functional checks of electrical systems:

Designation	Function
CxM	Electrical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative

Designation	Function
CQC	Contractor's Quality Control Personnel
EC	Contractor's Electrical Commissioning Representative

3.1.5.1.3 Mechanical and Plumbing Systems Test Team

The following team members must participate in Functional Performance of mechanical systems:

Designation	Function
CxM	Mechanical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
MC	Contractor's Mechanical Commissioning Representative
EC	Contractor's Electrical Commissioning Representative
CC	Contractor's Controls Commissioning Representative
TABC	Contractor's TAB Commissioning Representative

3.1.5.1.4 Electrical Systems Test Team

The following team members must participate in Functional Performance Testing of electrical systems:

Designation	Function
CxM	Mechanical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
EC	Contractor's Electrical Commissioning Representative

3.1.5.1.5 Other Pre-Functional and Functional Performance Participants

The following may participate as team members during Pre-Functional Checks and Functional Performance Testing:

Designation	Function
DPW	Directorate of Public Works Representative
BCE	Base Civil Engineer Office Representative
User	Using Agent's Representative

3.1.5.2 Pre-Functional Checks

Pre-Functional Checklists from the approved Final Construction Phase Commissioning Plan must be completed by the commissioning team. Complete one Pre-Functional Checklist for each individual item of equipment or system for each system required to be commissioned including, but not limited to, ductwork, piping, equipment, fixtures (plumbing), and controls. Indicate commissioning team member inspection and acceptance of each Pre-Functional Checklist item by initials. Acceptance of each Pre-Functional Checklist item by each team member indicates that item conforms to the construction contract requirements in their area of responsibility. Technical Commissioning Specialist acceptance of each Pre-Functional Checklist item indicates that each item has been installed correctly and in accordance with contract documents and the Owner's Project Requirements. Submit the completed and initialed Pre-Functional Checklists no later than 7 calendar days after completion of inspection of all checklists items for each system. Submit one hard copy and an electronic copy. Include manufacturer start-up checklists associated with equipment with the submission of the Pre-Functional Checklists.

3.1.5.3 Testing, Adjusting, and Balancing (TAB) Report and Field Acceptance Testing

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Identify any deficiencies to the Contracting Officer's Technical Representative and the Contractor's Quality Control Personnel. Resolve all deficiencies prior to TAB Field Acceptance Testing.

The Mechanical System Technical Commissioning Specialist must witness the TAB Field Acceptance Testing specified by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Include a certification by the Mechanical Technical Specialist that no outstanding deficiencies exist in the systems relative to Testing, Adjusting, and Balancing with the final TAB Report submittal.

3.1.5.4 HVAC Controls Test Reports

The Mechanical System Technical Commissioning Specialist must review the Start-Up Testing Report and the PVT Procedures and Reports required by Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. Include a certification by the Mechanical System Technical Commissioning Specialist that the submittals contain no deficiencies or that the submittals do not indicate any deficiencies in the HVAC systems or HVAC control systems with each of these submittals.

3.1.5.5 Tests

3.1.5.5.1 Functional Performance Tests

Schedule Functional Performance Tests for each system only after the Certificate of Readiness has been approved by the Government for the system. Correct all deficiencies identified through any prior review, inspection, or test activity before the start of Functional Performance Tests.

a. Functional Performance Tests must be performed with the Contracting Officer's Quality Assurance Representative present.

b. Abort Functional Performance Tests when any system deficiency prevents the successful completion of the test.

c. Technical Commissioning Specialists must lead and document all Functional Performance Tests for the systems to be commissioned with the Contractor and appropriate sub-contractors performing the Functional Performance Tests. The representatives listed in the paragraph Commissioning Team must attend the tests. Abort Functional Performance Tests when any required commissioning team member is not present for the test.

3.1.5.5.1.1 Checklist

Use the Functional Performance Test Checklists from the approved Final Construction Phase Commissioning Plan to guide the Functional Performance Tests. Functional Performance Tests must be performed for each item of equipment and each system required to be commissioned and verify all sensor calibrations, control responses, safeties, interlocks, operating modes, sequences of operation, capacities, and all other performance requirements comply with construction contract regardless of the specific items listed within the Functional Performance Test provided. Testing must progress from equipment or components to subsystems to systems to interlocks and connections between systems. The order of components and systems to be tested must be determined by the Technical Commissioning Specialists.

3.1.5.5.1.2 Acceptance

Indicate acceptance of each item of equipment and systems tested by signature of each commissioning team member for each Functional Performance Test. The Contractor's Quality Control Representative and the Technical Commissioning Specialists must indicate acceptance after the equipment and systems are free of deficiencies.

3.1.5.5.2 HVAC Test Methods

Perform Functional Performance Tests in accordance with the following:

3.1.5.5.2.1 Prior to Testing

Prior to system testing, complete control system feature, point-to-point, and actuator observations.

3.1.5.5.2.2 Simulating Conditions

Over-writing control input (actual) values through the controls system is

not acceptable, unless approved by the Contracting Officer's Technical Representative. Identify proposed exceptions in a protocol submitted to the Contracting Officer's Technical Representative for approval. Before simulating conditions, overwriting values (if approved), or changing set-points, calibrate all sensors, transducers and devices. Below are several examples of exceptions that would be considered acceptable:

a. When varying static pressures inside ductwork can not be simulated within the duct, and where a sensor signals the controls system to initiate sequences at various duct static pressures, it is acceptable to simulate the various pressures with a Pneumatic Squeeze-Bulb Type Signaling Device with gauge temporarily attached to the sensing tube leading to the transmitter. It is not acceptable to reset the various set-points, nor to simulate an electric analog signal (unless approved as noted above).

b. Dirty filter pressure drops can be simulated using sheets of cardboard at filter face.

c. Do not use signal generators to simulate sensor signals unless approved by the Contracting Officer's Technical Representative, as noted above, for special cases.

d. Control set points can be altered. For example, to see the air conditioning compressor lockout work at an outside air temperature below 13 degrees C, when the outside air temperature is above 13 degrees C, temporarily change the lockout set point to be minus 18 degrees C above the current outside air temperature. Caution: Set points are not to be raised or lowered to a point such that damage to the components, systems, or the building structure and/or contents will occur.

e. Test duct mounted smoke detectors in accordance with the manufacturer's recommendations. Perform the tests with air system at minimum airflow condition in ductwork.

f. Test current sensing relays used for fan and pump status signals to control system to indicate unit failure and run status by resetting the set point on the relay to simulate a lost belt or unit failure while the unit is running. Confirm that the failure alarm was generated and received at the control system. After the test is conducted, return the set point to its original set-point or a set-point as indicated by the Contracting Officer's Technical Representative.

3.1.5.5.2.3 Setup

Perform each test under conditions that simulate actual conditions as close as is practically possible. Provide all necessary materials and system modifications to produce the necessary flows, pressures, temperatures, and other conditions necessary to execute the test according to the specified conditions. At completion of the test, return the affected building equipment and systems to their pre-test condition.

3.1.5.5.3 Seasonal Tests

3.1.5.5.3.1 Initial Functional Performance Tests

Perform Initial Functional Performance Tests as soon as all contract work

is completed, regardless of the time of year. Develop and implement means of artificial loading to demonstrate, to a reasonable level of confidence, the ability of the HVAC systems to handle peak seasonal loads.

3.1.5.5.3.2 Full-Load Conditions

In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems under full-load conditions during peak cooling seasons during outdoor air condition design extremes.

Schedule Seasonal Functional Performance Tests in coordination with the Government.

3.1.5.5.3.3 System Acceptance

Systems may be partially accepted by the Government prior to seasonal testing if they comply with all construction contract that can be tested during initial Functional Performance Tests. All Functional Performance Test procedures must be completed prior to full systems acceptance.

3.1.5.5.4 Aborted Tests and Re-Testing

Abort Functional Performance Tests or Seasonal Tests if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Reimburse the Government for all costs associated with effort lost due to re-testing due to test failures and aborted tests. These costs must include salary, travel costs, and per diem for Government commissioning team members. Re-test only after all deficiencies identified during the original tests have been corrected.

3.1.6 Training Plan

The Technical Commissioning Specialists must develop training plans which identify all training required by specification sections associated with commissioned systems. Include a matrix listing each training requirement, content of the training, the trainer name, trainer contact information, and schedule and location of training. Submit one hard copy and an electronic copy of the Training Plan to the Commissioning Specialists and the Government no later than 30 calendar days prior to the associated training.

Document training attendance using training attendance rosters and provide completed attendance rosters to the Commissioning Specialists and the Government no later than 7 calendar days following the completion of training for each system to be commissioned. Submit one hard copy and an electronic copy.

3.1.7 Systems Manual

The Technical Commissioning Specialists must prepare and submit a Systems Manual including, for all commissioned systems, the Basis of Design, system single line diagrams, as-built sequences of operation and controls drawings, as-built control setpoints, recommended schedule for sensor and actuator calibration, recommended schedule of maintenance when not in the O&M manuals, recommended re-testing schedule with proposed testing forms, and full equipment warranty information. Update and resubmit the Systems Manual based on any corrective action taken during the warranty period.

Submit Systems Manual no later than 30 calendar days following completion of Functional Performance Tests. Submit three hard copies and an electronic copy.

3.2 COMMISSIONING REPORT

Following the completion of Functional Performance Tests, with the exception of Seasonal Tests, the Lead Commissioning Specialist must prepare a Commissioning Report.

a. Include an executive summary describing the overall commissioning process, the results of the commissioning process, any outstanding deficiencies and recommended resolutions, and any seasonal testing that must be scheduled for a later date. Indicate, in the executive summary, whether the systems meet the requirements of the construction contract and the Owner's Project Requirements.

b. Detail any deficiencies discovered during the commissioning process and the corrective actions taken in the report. Include the completed Pre-Functional Checklists, Functional Performance Test Checklists, the Commissioning Plans, the Issues Log, Performance Verification Test Reports, Training Attendance Rosters, the Design Review Report, the final TAB Report.

c. Submit the Commissioning Report no later than 14 calendar days following commissioning team acceptance of all Functional Performance Tests with the exception of Seasonal Tests. Submit three hard copies and an electronic copy.

d. Following any Seasonal Tests or Post-Construction Activities, update the Final Commissioning Report to reflect any changes and resubmit.

EXHIBIT A - OWNER'S PROJECT REQUIREMENTS DOCUMENT

OWNER'S PROJECT REQUIREMENTS DOCUMENT

Project: Shore to Ship Utilities
Location: SW Asia, Bahrain Island
Project Number: P964

Approved: Scott Wilhoite

Digitally signed by Scott Wilhoite
DN: C=US, E=scott.wilhoite10@jacobs.com, OU=Jacobs, CN=Scott Wilhoite
Date: 2020.09.24 11:36:00-04'00'

Name Design Agent's Representative Date

Digitally signed by MESSINA.THOMAS.S.1534262481
Date: 2020.09.24 12:07:58 -04'00'

Name Owner's Representative Date

1. Owner and User Requirements

a. Primary Purpose, Program, and Use

This project will eliminate the need for contracted ship husbandry services by providing permanently installed comprehensive utility distribution systems connected to six hotel stations for the Littoral Combat Ships (LCS) operations at NSA II Bahrain.

This project will construct comprehensive utility distribution systems and operational facilities to provide dedicated quayside shore-to-ship utility services for the LCS's and other mission-critical ships. Utility services provided by this project will include electrical, telecommunication, and potable water services, as well as waste liquid collection systems. Additional construction necessary to accomplish the infrastructure improvements include site civil work, additions to the existing Consolidated Utility Building, and a new Storage for Utility Services Building.

An option to this project is to provide more resiliency to the NSA II electrical system by interconnecting the primary electrical substation at NSA II with NSA I.

b. Project History

NSA Bahrain is the home of Naval Central Command Fifth Fleet Headquarters and provides operational ship support to U.S. and Coalition forces operating throughout the U.S. Naval Forces Central Command Area of Responsibility. Currently, shore to ship utility services along the quay wall at NSA II are provided for homeported, forward deployed, rotationally deployed, and visiting U.S. ships through local (non-Navy suppliers) husbandry contracts.

LCS operations, which represent a new mission, are scheduled to begin in 2019. This represents a significant increase in the operational tempo at NSA Bahrain and a corresponding impact within this operational theatre. The current ongoing, multi-phased waterfront development at NSA II does not include dedicated utility services for the LCS mission nor for other current and future ship berthing requirements.

c. Broad Goals

i. Future Expansion: This project will provide ship hotel services for a variety of 480 volt ships capable of berthing at the quay wall. The infrastructure is designed with approximately 20% spare capacity for future growth.

ii. Flexibility: Mission support for the LCSs requires utility infrastructure and facilities capable of supporting a projected daily on-board average of six LCSs. This shore to ship-based utility system will also be able to service compatible U.S. ships at NSA Bahrain.

iii. Quality of Materials: The materials supplied will be of the highest quality within the budget constraints. Systems are designed with a 25-year service life, at a minimum.

iv. Construction Costs: The goal of the cost is to get the best materials for the application while bringing the best value to the Navy. The cost are driven by the mission requirements and the materials described

in the applicable UFC's.

v. Operational Costs: The annual cost of such ship husbandry services currently averages $4M. With the inclusion of the LCSs, ship husbandry fees are estimated at $8.4M annually. With the implementation of this project, husbandry service equipment will be replaced with dedicated infrastructure.

2. Environmental and Sustainability Goals

a. LEED/Green Globes Goal

LEED or other third-party certification is not a requirement of this project.

3. Energy Efficiency Goals

a. Goals/Policy

Energy consumption of Building 810 will be 30% less than the ASHRAE 90.1, 2013 baseline per UFC 1-200-02 Paragraph 2-3.

b. Systems and Feature Energy Impacts

Building 810 envelope will include R40 roof insulation and R20 wall insulation. Energy star cooling equipment will be specified for the CUBA. Only energy efficient transformers are specified.

4. Indoor Environmental Quality Requirements

a. Space Type 1: CUB Addition and Building 810 Communications Room

i. Intended Use: The spaces provide utility support

ii. Occupancy Schedule: There are no full time occupants associated with the space. Occupancy is variable for operations and maintenance tasks only.

iii. Environmental Requirements: The space will be maintained at 78 degrees F and a targeted 50 percent humidity.

iv. Occupant System Control Ability: Occupants will have local control of space temperature setpoint and lighting.)

v. Type of Lighting: All specified light fixtures are LED type.

vi. After-hour Use Accommodations: Space is rarely used after hours but may be active for maintenance activities.

b. Space Type 2: Building 810 Storage Area

i. Intended Use: Storage for Hotel Station support equipment.

ii. Occupancy Schedule: Maximum occupancy is 10 personnel. Occupancy will be variable throughout the day in support of vessel arrival and departure.

iii. Environmental Requirements: The space will be maintained at 78 degrees F and a targeted 50 percent humidity. Positive pressure will be maintained within the space.

iv. Occupant System Control Ability: Occupants will have local control of space temperature setpoint and lighting.

v. Type of Lighting: All specified light fixtures are LED type.

vi. After-hour Use Accommodations: Space is rarely used after hours but may be active depending on mission support requirements.

c. Space Type 3: Mechanical and Electrical Rooms

i. Intended Use: Dedicated space for mechanical and electrical equipment.

ii. Occupancy Schedule: There are no full time occupants associated with the space. Occupancy is variable for operations and maintenance tasks only.

iii. Environmental Requirements: The space will be maintained at 90 degrees F.

iv. Occupant System Control Ability: Occupants will have local control of lighting.

v. Type of Lighting: All specified light fixtures are LED type.

vi. After-hour Use Accommodations: Space is rarely used after hours but

may be active for maintenance activities.

d. Space Type 4: Battery Charging

i. Intended Use: Dedicated space for charging industrial lift truck batteries.

ii. Occupancy Schedule: There are no full time occupants associated with the space. Occupancy is variable for operations and maintenance tasks only.

iii. Environmental Requirements: The space will be ventilated continuously at 6 air changes per hour to maintain hydrogen concentration below 25 percent of the LEL. Makeup air for the ventilation will be transferred from the storage space.

iv. Occupant System Control Ability: Occupants will have local control of lighting.

v. Type of Lighting: All specified light fixtures are LED type.

vi. After-hour Use Accommodations: Space is rarely used after hours but may be active for maintenance activities.

3. Space Type 4: Restroom

i. Intended Use: Space with sanitary fixtures for biological comfort.

ii. Occupancy Schedule: There are no full time occupants associated with the space. Occupancy is variable at all times.

iii. Environmental Requirements: The space will be ventilated continuously per ASHRAE 62.1. Makeup air for the ventilation will be transferred from the storage space.

iv. Occupant System Control Ability: Occupants will have local control of lighting.

v. Type of Lighting: All specified light fixtures are LED type.

vi. After-hour Use Accommodations: Space is rarely used after hours but may be active for mission demands.

5. Equipment and System Expectations

a. HVAC Systems

i. Quality and Reliability: Equipment efficiency should meet ASHRAE and FEMP/Energy Star requirements. No specific quality or reliability requirements specified. Equipment should remain serviceable over life of building or to the extent typical of the type of equipment. Duplex chilled water pumps and battery exhaust fans are should be provided.

ii. Type: Cooling for the SFUS should be provided by an air-cooled chiller and central station air handling unit. Small spaces and additions should be conditioned with mini-split systems.

iii. Automation: Control HVAC systems from stand-alone DDC equipment. DDC shall be capable of future UMCS connection.

iv. Flexibility: Operation of the CUBA and Building 810 will remain mostly unchanged; flexibility of the system is not required.

v. Maintenance Requirements: Equipment is to be located to allow ready maintenance activities.

b. Lighting Systems

i. Quality and Reliability: The building lighting should meet the requirements of UFC 3-530-01.

(Example: The building lighting system should meet ASHRAE 90.1 - SI requirements.)

ii. Type: LED lighting will be utilized. Occupancy sensors shall be used for lighting controls for restroom and warehouse spaces. Mechanical, electrical, and telecommunication spaces will utilize manual switches only for personnel safety. Target foot-candles should be in accordance with UFC 3-530-01.

iii. Automation: Lighting controls will be required in restrooms and warehouse spaces. Mechanical, electrical, and telecom spaces will utilize manual switches.

iv. Flexibility: All lights in each enclosed space will be controlled together. Lighting in the warehouse is not required to be zoned by aisle or broken into other sub-spaces. Lights do not need to be dimmed.

v. Lights are LED with minimal required maintenance aside from replacement at end of life.

c. Domestic Hot Water Systems

i. Quality and Reliability: No specific quality or reliability requirements specified. Equipment should remain serviceable over life of building or to the extent typical of the type of equipment.

ii. Type: Instantaneous electric water heater at lavatories.

iii. Automation: Manufacturer's standard controls are adequate for the instantaneous water heater.

iv. Flexibility: No anticipated changes to restroom layout; no additional flexibility required.

v. Maintenance Requirements: Equipment is to be located to allow ready maintenance activities.

d. On-site Power Systems

i. Quality and Reliability: Equipment providing services to the ships or the power to the ships will have a redundant source of power as follows:

New RO Equipment: Stand-by generator system

New Lift stations: Provisions for a roll-up generator

Electrical Hoteling Stations: Redundant (loop fed) distribution, including redundant frequency converters and switches.

The new SFUS building does not require a redundant source of power.

Emergency lighting will be provided with batteries.

The entire utility is not required to be backed up to support this work, only the segments mentioned.

ii. Type: The 11 kV distribution is currently in a loop feed arrangement. A new 11 kV loop will be added to provide power to the ships.

iii. Automation: There will not be any automation of the 11 kV system. Pad mounted switches will be used to manually reroute power in the case maintenance or other work is needed. In the event of a complete utility power loss, equipment will need to be manually brought back online in a controlled sequence.

iv. Flexibility: There needs to be some flexibility in the 11 kV distribution to accommodate for rerouting of power and also to allow for six ships to be docked at any of 12 locations (six double-berthed hoteling stations).

v. Maintenance Requirements: It is assumed that there will be additional construction on this site and access to the existing manholes will be required. This requires the loop fed underground distribution to have a unique path so that manholes can be completely de-energized when power is rerouted. New electrical distribution equipment is anticipated to have minimal maintenance requirements after start-up.

6. Building Occupant and O&M Personnel Requirements

a. Facility Operation

The facilities will be maintained by PWD Bahrain.

b. UMCS (EMCS or FMCS)

The facilities will initially include only stand-alone DDC control with no UMCS.

c. Occupant Training and Orientation

Building occupants will not be trained on the installed systems.

d. O&M Staff Training and Orientation

O&M staff should be trained on all aspects of the building systems including interactions between multiple systems and troubleshooting the individual systems as well as the integrated operations.

-- End of Section --

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SECTION 02 41 00

DEMOLITION
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2012) Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.6	(2006) Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants

1.2 PROJECT DESCRIPTION

1.2.1 Definitions

1.2.1.1 Demolition

Demolition is the process of wrecking or taking out any load-supporting structural member of a facility together with any related handling and disposal operations.

1.2.1.2 Deconstruction

Deconstruction is the process of taking apart a facility with the primary goal of preserving the value of all useful building materials.

1.2.1.3 Demolition Plan

Demolition Plan is the planned steps and processes for managing demolition activities and identifying the required sequencing activities and disposal mechanisms.

1.2.1.4 Deconstruction Plan

Deconstruction Plan is the planned steps and processes for dismantling all or portions of a structure or assembly, to include managing sequencing activities, storage, re-installation activities, salvage and disposal mechanisms.

1.2.2 Demolition/Deconstruction Plan

Prepare a Demolition Plan and Deconstruction Plan and submit proposed salvage, demolition, deconstruction, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.3 General Requirements

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes the value derived from the salvage and recycling of materials. The work includes demolition, deconstruction, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement,

or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.3.3 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor.

1.3.4 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Demolition Plan; G R

Deconstruction Plan; G R

Traffic Control Plan; G R

Existing Conditions; G R

SD-07 Certificates

Notification

1.6 QUALITY ASSURANCE

Submit timely notification of demolition and deconstruction projects to Host Nation in accordance with 40 CFR 61, Subpart M. Notify the local air pollution control district/agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with Host Nation hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSP A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to flooding or pollution. Vacuum and dust the work area daily. Sweep pavements as often as necessary to control the spread of debris.

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Submit a traffic control plan to the Contracting Officer for approval prior to demolition work.

b. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind. Notify the Contracting Officer prior to beginning such work.

1.7.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items

as approved by the Contracting Officer.

1.9 EXISTING CONDITIONS

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 200 mm x 250 mm will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Fill material shall conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 50 mm in any dimension.

b. Proposed fill material must be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D

PART 3 EXECUTION

3.1 EXISTING FACILITIES

Remove existing roof system down to the existing substrate as required for new roof installation. Remove partial existing exterior facade as required for the new construction. Refer to the drawings for demolition scope.

3.1.1 Utilities and Related Equipment

3.1.1.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.1.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area.

3.1.2 Paving and Slabs

Provide neat saw cuts at limits of pavement removal as indicated. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.3 Concrete

Saw concrete along straight lines to a depth of a minimum 50 mm. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.4 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.2.2 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable combustible material in the

sanitary fill area located off the site.

3.3 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other non-salvageable materials resulting from removal operations with all applicable Host Nation regulations as contractually specified in the Waste Management Plan. Storage of removed materials on the project site is prohibited.

3.4.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.4.3 Removal from Government Property

Transport waste materials removed from demolished structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.5 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE
02/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 224.3R	(1995; Reapproved 2013) Joints in Concrete Construction
ACI 301	(2016) Specifications for Structural Concrete
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 304.2R	(2017) Guide to Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305.1	(2014) Specification for Hot Weather Concreting
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 347R	(2014; Errata 1 2017) Guide to Formwork for Concrete
ACI SP-15	(2011) Field Reference Manual: Standard Specifications for Structural Concrete ACI 301-05 with Selected ACI References
ACI SP-2	(2007; Abstract: 10th Edition) ACI Manual of Concrete Inspection

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1044/A1044M	(2016a) Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A184/A184M	(2017) Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C1017/C1017M	(2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1074	(2011) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1107/C1107M	(2017) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1218/C1218M	(2017) Standard Test Method for

	Water-Soluble Chloride in Mortar and Concrete
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	(2008; R 2015) Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C143/C143M	(2015) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2018) Standard Specification for Portland Cement
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C1778	(2016) Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C31/C31M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C330/C330M	(2017a) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C39/C39M	(2018) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2018a) Standard Test Method for Obtaining

	and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	(2017) Standard Specification for Chemical Admixtures for Concrete
ASTM C78/C78M	(2018) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C803/C803M	(2018) Standard Test Method for Penetration Resistance of Hardened Concrete
ASTM C873/C873M	(2015) Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
ASTM C900	(2015) Standard Test Method for Pullout Strength of Hardened Concrete
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2018) Standard Specification for Ready-Mixed Concrete
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2628	(1991; R 2016) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	(1989; R 2017) Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D3042	(2017) Standard Test Method for Insoluble Residue in Carbonate Aggregates
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D6690	(2015) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

ASTM E1155	(2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E1643	(2018a) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2017) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E1993/E1993M	(1998; R 2013; E 2013) Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
ASTM E329	(2018) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

BRITISH STANDARDS INSTITUTE (BSI)

BS EN 12390-2	(2009) Testing Hardened Concrete Part 2: Making and Curing Specimens for Strength Tests
BS EN 12390-3	(2009) Testing Hardened Concrete Part 3: Compressive Strength of Test Specimens

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed; Errata) Manual of Standard Practice
CRSI RB4.1	(2016) Supports for Reinforcement Used in Concrete

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2015) Principles and Criteria for Forest Stewardship

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2008; Corr 1 2009) Quality Management Systems- Requirements

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2009) DOC Voluntary Product Standard PS 1-07, Structural Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, and slag cement.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.

e. "Mass Concrete" is any concrete system that approaches a maximum temperature of 70 degrees C within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 1 meter or more regardless of temperature.

f. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.

g. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.

h. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Concrete Curing Plan; G R

Construction Joints Plan; G R

Quality Control Plan; G R

Quality Control Personnel Certifications; G R

Quality Control Organizational Chart; G R

Laboratory Accreditation; G R

Form Removal Schedule; G R

Maturity Method Data; G R

SD-02 Shop Drawings

Formwork; G R

Reinforcing Steel; G R

SD-03 Product Data

Joint Sealants

Joint Filler

Formwork Materials

Recycled Aggregate Materials

Cementitious Materials

Vapor Barrier

Concrete Curing Materials

Reinforcement

Liquid Chemical Floor Hardeners and Sealers

Admixtures

Mechanical Reinforcing Bar Connectors

Waterstops

Local/Regional Materials

Biodegradable Form Release Agent

Nonshrink Grout

SD-05 Design Data

Concrete Mix Design; G R

Formwork Calculations; G R

SD-06 Test Reports

Concrete Mix Design; G R

Aggregates; G R

Compressive Strength Tests; G R

Air Content; G R

Slump Tests; G R

Water; G R

SD-07 Certificates

Reinforcing Bars

Welder Qualifications

VOC Content for Form Release Agents, Curing Compounds, and Concrete Penetrating Sealers

Safety Data Sheets

Forest Stewardship Council (FSC) Certification

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Liquid Chemical Floor Hardeners and Sealers

Joint Sealants

Curing Compounds

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301, ACI 304R and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Formwork Calculations

ACI 347R. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Furnish drawings and calculations of shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members. Calculations must indicate concrete pressure with both live and dead loads, along with material types.

1.6.1.2 Concrete Mix Design

Concrete supplier must be ISO 9001 certified. Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Indicate placement schedule, construction, location and method of forming control joints. Include locations of inserts, conduit, sleeves and other embedded items. Reproductions of contract drawings are unacceptable. Submit form removal schedule indicating element and minimum length of time for form removal.

Design, fabricate, erect, support, brace, and maintain formwork so that it is able to support, without failure, all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

1.6.2.2 Reinforcing Steel

Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to

determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

1.6.3 Control Submittals

1.6.3.1 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with ACI 308.1.

1.6.3.2 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.3.3 Safety Data Sheets

Submit Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. SDS must be readily accessible during each work shift to employees when they are at the construction site.

1.6.4 Test Reports

1.6.4.1 Aggregates

Submit test results in accordance with ASTM C33/C33M, or ASTM C330/C330M for lightweight aggregate, and ASTM C1293 or ASTM C1567 as required in the paragraph titled ALKALI-AGGREGATE REACTION.

1.6.5 Quality Control Plan

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan must include approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the Contracting Officer, Quality Manager and Concrete Supplier. Maintain a copy of ACI SP-15 and CRSI 10MSP at project site.

1.6.6 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the various positions. Quality control personnel must be employed by the Contractor.

Submit American Concrete Institute certification for the following:

a. CQC personnel responsible for inspection of concrete operations.

b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.

c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

1.6.6.1 Quality Manager Qualifications

The quality manager must hold a current license as a professional engineer in a U.S. state or local equivalent with experience on at least five similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

1.6.6.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.

b. Testing agencies that perform testing services on reinforcing steel must meet the requirements of ASTM E329.

c. Testing agencies that perform testing services on concrete materials must meet the requirements of ASTM C1077.

1.6.7 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of ASTM C1077 and be Cement and Concrete Reference Laboratory (CCRL) inspected.

1.6.8 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a professional engineer who is competent in concrete materials and must sign all reports and designs.

b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M or BS EN 12390-2.

c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to material manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing period or for 72 hours after installation:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 13 degrees C and 29 degrees C and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

a. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.

b. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.

c. Provide product data stating the location where all products were manufactured

d. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.

e. For projects using reusable formwork, provide data showing how formwork is reused.

f. Provide SDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.

g. Provide SDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

1.8.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

1.9 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with AWS D1.4/D1.4M.

Verify that Welder qualifications are in accordance with AWS D1.4/D1.4M for welding of reinforcement or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

a. Form-facing material in contact with concrete must be lumber, plywood, tempered concrete-form-grade hardboard, metal, plastic, or treated paper that creates specified appearance and texture of concrete surface. Submit product information on proposed form-facing materials if different from that specified herein.

b. Design formwork, shores, reshores, and backshores to support loads transmitted to them and to comply with applicable building code requirements.

c. Design formwork and shoring for load redistribution resulting from stressing of post-tensioned reinforcement. Ensure that formwork allows movement resulting from application of prestressing force.

d. Design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.

e. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.

f. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.

g. Design formwork joints to inhibit leakage of mortar.

h. Limit deflection of facing materials for concrete surfaces exposed to view to 1/240 of center-to-center spacing of facing supports.

i. Submit product information on proposed form-facing materials if different from that specified herein.

j. Submit shop drawings for formwork, shoring, reshoring, and backshoring. Shop drawings must be signed and sealed by a licensed design engineer.

k. Submit design calculations for formwork, shoring, reshoring, and backshoring. Design calculations must be signed and sealed by a licensed design engineer.

l. Submit procedure for reshoring and backshoring, including drawings signed and sealed by a licensed design engineer. Include on shop drawings the formwork removal procedure and magnitude of construction loads used for design of reshoring or backshoring system. Indicate in procedure the magnitude of live and dead loads assumed for required capacity of the structure at time of reshoring or backshoring.

m. Submit manufacturer's product data on form liner proposed for use with each formed surface.

2.1.1 Wood Forms

Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Submit data verifying that composite wood products contain no urea formaldehyde resins.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 16 mm thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 16 mm thick.

2.1.2 Plastic Forms

Provide plastic forms that contain a minimum of 50 percent post-consumer recycled content, or a minimum of 50 percent post-industrial recycled content.

2.1.3 Carton Forms

Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content.

2.1.4 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORMWORK ACCESSORIES

a. Use commercially manufactured formwork accessories, including ties and hangers.

b. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Form Ties

a. Use form ties with ends or end fasteners that can be removed without damage to concrete.

b. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in walls.

c. The breakback distance for ferrous ties must be at least 50 mm for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.

d. Submit manufacturer's data sheet on form ties.

2.2.2 Waterstops

Submit manufacturer's data sheet on waterstop materials and splices.

2.2.2.1 PVC Waterstop

Polyvinylchloride waterstops must conform to COE CRD-C 572.

2.2.2.2 Rubber Waterstop

Rubber waterstops must conform to COE CRD-C 513.

2.2.2.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops must conform to ASTM D471.

2.2.2.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to the following requirements when tested in accordance to ASTM D412: Tensile strength 2.9 MPa minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 20 degrees C must be 3 to 1 minimum.

2.2.3 Biodegradable Form Release Agent

a. Provide form release agent that is colorless, biodegradable, and rapeseed oil-based, soy oil-based, or water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content.

b. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

c. Provide form release agent that reduces formwork moisture absorption, and does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

d. Submit manufacturer's product data on formwork release agent for use on each form-facing material.

2.2.4 Chamfer Materials

Use lumber materials with dimensions of 19 x 19 mm.

2.2.5 Construction and movement joints

a. Submit construction joints plan. Submit details and locations of construction joints in accordance with the requirements herein.

b. Locate construction joints within middle one-third of spans of slabs, beams, and girders. If a beam intersects a girder within the middle

one-third of girder span, the distance between the construction joint in the girder and the edge of the beam must be at least twice the width of the larger member.

c. Locate construction joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.

d. Make construction joints perpendicular to main reinforcement.

e. Provide movement joints where indicated in Contract Documents or in accepted alternate locations.

f. Submit location and detail of movement joints if different from those indicated in Contract Documents.

g. Submit manufacturer's data sheet on expansion joint materials.

h. Provide keyways where indicated in Contract Documents.

2.2.6 Other Embedded items

Use sleeves, inserts, anchors, and other embedded items of material and design indicated in Contract Documents.

2.3 CONCRETE MATERIALS

2.3.1 Cementitious Materials

2.3.1.1 Portland Cement

a. Unless otherwise specified, provide cement that conforms to ASTM C150/C150M Type V.

b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

c. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials.

d. Submit information along with evidence demonstrating compliance with referenced standards. Submittals must include types of cementitious materials, manufacturing locations, shipping locations, and certificates showing compliance.

e. Cementitious materials must be stored and kept dry and free from contaminants.

2.3.2 Water

a. Water or ice must comply with the requirements of ASTM C1602/C1602M.

b. Minimize the amount of water in the mix. Improve workability by adjusting the grading of the aggregate and using admixture rather than by adding water.

c. Water must be potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

d. Protect mixing water and ice from contamination during storage and delivery.

e. Submit test report showing water complies with ASTM C1602/C1602M.

2.3.3 Aggregate

2.3.3.1 Normal-Weight Aggregate

a. Aggregates must conform to ASTM C33/C33M.

b. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in concrete represented by submitted field test records or used in trial mixtures.

c. Provide sand that is at least 50 percent acid insoluble based on ASTM D3042.

d. Store and handle aggregate in a manner that will avoid segregation and prevents contamination by other materials or other sizes of aggregates. Store aggregates in locations that will permit them to drain freely. Do not use aggregates that contain frozen lumps.

e. Submit types, pit or quarry locations, producers' names, aggregate supplier statement of compliance with ASTM C33/C33M, and ASTM C1293 expansion data not more than 18 months old.

2.3.3.2 Recycled Aggregate Materials

Use a minimum of 25 percent recycled aggregate, depending on local availability and conforming to requirements of the mix design. Recycled aggregate to include: recovered glass, recovered concrete, recovered porcelain, or recovered stone that meets the aggregate requirements specified. Submit recycled material request with the aggregate certification submittals and do not use until approved by the Contracting Officer.

2.3.4 Admixtures

a. Chemical admixtures must conform to ASTM C494/C494M.

b. Air-entraining admixtures must conform to ASTM C260/C260M.

c. Chemical admixtures for use in producing flowing concrete must conform to ASTM C1017/C1017M.

d. Do not use calcium chloride admixtures.

e. Use a corrosion-inhibiting admixture for concrete classified under exposure category C2. Use an ASR-inhibiting admixture for concrete containing aggregate susceptible to ASR.

f. Admixtures used in concrete must be the same as those used in the concrete represented by submitted field test records or used in trial mixtures.

g. Protect stored admixtures against contamination, evaporation, or damage.

h. To ensure uniform distribution of constituents, provide agitating equipment for admixtures used in the form of suspensions or unstable solutions. Protect liquid admixtures from freezing and from temperature changes that would adversely affect their characteristics.

i. Submit types, brand names, producers' names, manufacturer's technical data sheets, and certificates showing compliance with standards required herein.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete Curing Materials

Provide concrete curing material in accordance with ACI 301 Section 5 and ACI 308.1 Section 2. Submit product data for concrete curing compounds. Submit manufactures instructions for placement of curing compound.

2.4.2 Nonshrink Grout

Nonshrink grout in accordance with ASTM C1107/C1107M.

2.4.3 Floor Finish Materials

2.4.3.1 Liquid Chemical Floor Hardeners and Sealers

a. Hardener must be a colorless aqueous solution containing a blend of inorganic silicate or siliconate material and proprietary components combined with a wetting agent; that penetrates, hardens, and densifies concrete surfaces. Submit manufactures instructions for placement of liquid chemical floor hardener.

b. Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content. Submit manufactures instructions for placement of sealers.

2.4.4 Expansion/Contraction Joint Filler

ASTM D1751 or ASTM D1752 Type I or Type II. Material must be 13 mm thick, unless otherwise indicated.

2.4.5 Joint Sealants

Submit manufacturer's product data, indicating VOC content.

2.4.5.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

2.4.5.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C920, Type M, Grade NS, Class 25, Use T.

2.4.5.3 Preformed Polychloroprene Elastomeric Type

ASTM D2628.

2.4.5.4 Lubricant for Preformed Compression Seals

ASTM D2835.

2.4.6 Vapor Barrier

ASTM E1745 Class C polyethylene sheeting, minimum 0.38 mm thickness or ASTM E1993/E1993M bituminous membrane or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M.

2.4.7 Dovetail Anchor Slot

Preformed metal slot approximately 25 mm by 25 mm of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

2.5 CONCRETE MIX DESIGN

2.5.1 Properties and Requirements

a. Use materials and material combinations listed in this section and the contract documents.

b. Cementitious material content must be adequate for concrete to satisfy the specified requirements for strength, w/cm, durability, and finishability described in this section and the contract documents. The minimum cementitious material content must be 340 kg per cubic meter.

c. The measured slump must not exceed 200 mm for concrete with verified slump of 50 to 100 mm before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 25 mm. Concrete must not show visible signs of segregation. The target slump must be enforced for the duration of the project. Determine the slump by ASTM C143/C143M. Slump tolerances must meet the requirements of ACI 117.

d. The maximum water-cementitious materials ratio must not exceed 0.40.

e. The nominal maximum size of coarse aggregate for a mixture must not exceed three-fourths of the minimum clear spacing between reinforcement, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

f. Measure air content at the point of delivery in accordance with ASTM C173/C173M or ASTM C231/C231M.

g. Concrete for slabs to receive a hard-troweled finish must not contain an air-entraining admixture or have a total entrapped air content greater than 3 percent.

h. Concrete properties and requirements for each portion of the structure are specified in the table below. Refer to the paragraph titled DURABILITY for more details on exposure categories and their requirements.

	Minimum f'_c MPa	Exposure Categories^	Miscellaneous Requirements
All concrete except slabs	45 (cube) 35 (cylindrical) at 28 days	S1; C2	Nominal maximum aggregate size must be 20 mm Air Content: 6 percent, plus or minus 1.5 percent at point of delivery
Slabs	45 (cube) 35 (cylindrical) at 28 days	S1; C2	Nominal maximum aggregate size must be 20 mm

2.5.2 Durability

2.5.2.1 Alkali-Aggregate Reaction

Do not use any aggregate susceptible to alkali-carbonate reaction (ACR). Use one of the three options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction (ASR):

a. For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 must not exceed 0.04 percent at one year.

b. For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 must not exceed 0.10 percent at an age of 16 days.

c. Alkali content in concrete (LBA) must not exceed 2.4 kg per cubic meter for moderately reactive aggregate or 1.8 kg per cubic meter for highly reactive aggregate. Reactivity must be determined by testing in accordance with ASTM C1293 and categorized in accordance with ASTM C1778. Alkali content is calculated as follows:
LBA = (cement content, kg per cubic meter) × (equivalent alkali content of portland cement in percent/100 percent)

2.5.2.2 Corrosion and Chloride Content

a. Submit documentation verifying compliance with specified requirements.

b. Water-soluble chloride ion content contributed from constituents including water, aggregates, cementitious materials, and admixtures must be determined for the concrete mixture by ASTM C1218/C1218M at age between 28 and 42 days.

c. The maximum water-soluble chloride ion (Cl-) content in concrete, percent by mass of cement is 0.15.

2.5.2.3 Concrete Temperature

The temperature of concrete as delivered must not exceed 35 degrees C.

2.5.3 Trial Mixtures

Trial mixtures must be in accordance to ACI 301.

2.5.4 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

a. Type and brand cement

b. Cement content in 43-kilogram bags per cubic meter of concrete

c. Maximum size of aggregate

d. Amount and brand name of admixtures

e. Total water content expressed by water cementitious material ratio

2.6 REINFORCEMENT

a. Bend reinforcement cold. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117.

b. When handling and storing coated reinforcement, use equipment and methods that do not damage the coating. If stored outdoors for more than 2 months, cover coated reinforcement with opaque protective material.

c. Submit manufacturer's certified test report for reinforcement.

d. Submit placing drawings showing fabrication dimensions and placement locations of reinforcement and reinforcement supports. Placing drawings must indicate locations of splices, lengths of lap splices, and details of mechanical and welded splices.

e. Submit request with locations and details of splices not indicated in Contract Documents.

f. Submit request to place column dowels without using templates.

g. Submit request for field cutting, including location and type of bar to be cut and reason field cutting is required.

2.6.1 Reinforcing Bars

a. Reinforcing bars must be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.

b. ASTM A615/A615M with the bars marked A, Grade 420; or ASTM A996/A996M with the bars marked R, Grade 420, or marked A, Grade 420.

c. Submit mill certificates for reinforcing bars.

2.6.1.1 Bar Mats

a. Bar mats must conform to ASTM A184/A184M.

2.6.1.2 Headed Shear Stud Reinforcement

Headed studs and headed stud assemblies must conform to ASTM A1044/A1044M.

2.6.2 Mechanical Reinforcing Bar Connectors

a. Provide 125 percent minimum yield strength of the reinforcement bar.

b. Mechanical splices for galvanized reinforcing bars must be galvanized or coated with dielectric material.

c. Mechanical splices used with epoxy-coated or dual-coated reinforcing bars must be coated with dielectric material.

d. Submit data on mechanical splices demonstrating compliance with this paragraph.

2.6.3 Wire

a. Plain or deformed steel wire must conform to ASTM A1064/A1064M.

2.6.4 Reinforcing Bar Supports

a. Provide reinforcement support types within structure as required by Contract Documents. Reinforcement supports must conform to CRSI RB4.1. Submit description of reinforcement supports and materials for fastening coated reinforcement if not in conformance with CRSI RB4.1.

b. Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

c. Minimum 10 percent post-consumer recycled content, or minimum 20 percent post-industrial recycled content.

2.6.5 Dowels for Load Transfer in Floors

Provide plate dowels for load transfer in floors of the type, design, weight, and dimensions indicated.

Plate dowels must conform to ASTM A36/A36M, and must be of size and spacing indicated. Plate dowel system must minimize shrinkage restraint by using a tapered shape basket assembly at control joints and formed void system at construction joints.

2.6.6 Welding

a. Provide weldable reinforcing bars that conform to ASTM A706/A706M and ASTM A615/A615M and Supplement S1, Grade 420, except that the maximum carbon content must be 0.55 percent.

b. Comply with AWS D1.4/D1.4M unless otherwise specified. Do not tack weld reinforcing bars.

c. Welded assemblies of steel reinforcement produced under factory conditions, such as welded wire reinforcement, bar mats, and deformed

bar anchors, are allowed.

PART 3 EXECUTION

3.1 EXAMINATION

a. Do not begin installation until substrates have been properly constructed; verify that substrates are level.

b. If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.

c. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

a. Surfaces against which concrete is to be placed must be free of debris, loose material, standing water and other deleterious substances before start of concrete placing.

b. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

a. When subgrade material is semi-porous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor retarder.

b. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

3.2.3 Subgrade Under Slabs on Ground

a. Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

b. Previously constructed subgrade or fill must be cleaned of foreign materials

c. Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 6.4 mm when tested with a 3000 mm straightedge parallel with and at right angles to building lines.

d. Finished surface of subgrade or fill under exterior slabs on ground must not be more than 6.10 mm above or 30.50 mm below elevation indicated.

3.2.4 Edge Forms and Screed Strips for Slabs

a. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment.

b. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.5 Reinforcement and Other Embedded Items

a. Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

b. When concrete is placed, reinforcement must be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimensions, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.

3.3 FORMS

a. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade.

b. Chamfer above grade exposed joints, edges, and external corners of concrete 20 mm. Place chamfer strips in corners of formwork to produce beveled edges on permanently exposed surfaces. Do not bevel reentrant corners or edges of formed joints of concrete.

c. Provide formwork with clean-out openings to permit inspection and removal of debris.

d. Inspect formwork and remove foreign material before concrete is placed.

e. At construction joints, lap form-facing materials over the concrete of previous placement. Ensure formwork is placed against hardened concrete so offsets at construction joints conform to specified tolerances.

f. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in formwork after concrete has reached initial setting. Brace formwork to resist lateral deflection and lateral instability.

g. Fasten form wedges in place after final adjustment of forms and before concrete placement.

h. Provide anchoring and bracing to control upward and lateral movement of formwork system.

i. Construct formwork for openings to facilitate removal and to produce opening dimensions as specified and within tolerances.

j. Provide runways for moving equipment. Support runways directly on

formwork or structural members. Do not support runways on reinforcement. Loading applied by runways must not exceed capacity of formwork or structural members.

k. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with removable material to prevent concrete entry into voids.

l. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete placement.

m. Comply with ACI 301 Sections 2 and 5, and ACI 347R.

3.3.1 Coating

a. Cover formwork surfaces with an acceptable material that inhibits bond with concrete.

b. If formwork release agent is used, apply to formwork surfaces in accordance with manufacturer's recommendations before placing reinforcement. Remove excess release agent on formwork prior to concrete placement.

c. Do not allow formwork release agent to contact reinforcement or hardened concrete against which fresh concrete is to be placed.

3.3.2 Reshoring

a. Do not allow structural members to be loaded with combined dead and construction loads in excess of loads indicated in the accepted procedure.

b. Install and remove reshores or backshores in accordance with accepted procedure.

c. For floors supporting shores under newly placed concrete, either leave original supporting shores in place, or install reshores or backshores. Shoring system and supporting slabs must resist anticipated loads. Locate reshores and backshores directly under a shore position or as indicated on formwork shop drawings.

3.3.3 Reuse

a. Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

b. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.

c. Remove leaked mortar from formwork joints before reuse.

d. Reuse forms must not contain pre-used holes and openings to prevent mortar/paste leakage. Closing materials used for minor openings must be installed per the manufacturer's recommendations.

e. Use form-release agent for reused forms.

3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-1.0, for formed surfaces that are to be concealed by other construction.

3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view.

3.3.6 Form Ties

a. For post-tensioned structures, do not remove formwork supports until stressing records have been accepted by the Contracting Officer.

b. After ends or end fasteners of form ties have been removed, repair tie holes in accordance with ACI 301 Section 5 requirements.

3.3.7 Tolerances for Form Construction

a. Construct formwork so concrete surfaces conform to tolerances in ACI 117.

b. Position and secure sleeves, inserts, anchors, and other embedded items such that embedded items are positioned within ACI 117 tolerances.

c. To maintain specified elevation and thickness within tolerances, install formwork to compensate for deflection and anticipated settlement in formwork during concrete placement. Set formwork and intermediate screed strips for slabs to produce designated elevation, camber, and contour of finished surface before formwork removal. If specified finish requires use of vibrating screeds or roller pipe screeds, ensure that edge forms and screed strips are strong enough to support such equipment.

3.3.8 Removal of Forms and Supports

a. If vertical formed surfaces require finishing, remove forms as soon as removal operations will not damage concrete.

b. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform repairs and finishing operations required. If forms are removed before end of specified curing period, provide curing and protection.

c. Do not damage concrete during removal of vertical formwork for columns, walls, and sides of beams. Perform needed repair and finishing operations required on vertical surfaces. If forms are removed before end of specified curing period, provide curing and protection.

d. Leave formwork and shoring in place to support construction loads and weight of concrete in beams, slabs, and other structural members until in-place required strength of concrete is reached.

e. Form-facing material and horizontal facing support members may be removed before in-place concrete reaches specified compressive

strength if shores and other supports are designed to allow facing removal without deflection of supported slab or member.

3.3.9 Strength of Concrete Required for Removal of Formwork

If removal of formwork, reshoring, or backshoring is based on concrete reaching a specified in-place strength, mold and field-cure cylinders or cubes in accordance with ASTM C31/C31M or BS EN 12390-2. Test cylinders or cubes in accordance with ASTM C39/C39M or BS EN 12390-3. Alternatively, use one or more of the methods listed herein to evaluate in-place concrete strength for formwork removal.

a. Tests of cast-in-place cylinders in accordance with ASTM C873/C873M. This option is limited to slabs with concrete depths from 12.5 to 30 cm.

b. Penetration resistance in accordance with ASTM C803/C803M.

c. Pullout strength in accordance with ASTM C900.

d. Maturity method in accordance with ASTM C1074. Submit maturity method data using project materials and concrete mix proportions used on the project to demonstrate the correlation between maturity and compressive strength of laboratory cured test specimens to the Contracting Officer.

3.4 WATERSTOP INSTALLATION AND SPLICES

a. Provide waterstops in construction joints as indicated.

b. Install formwork to accommodate waterstop materials. Locate waterstops in joints where indicated in Contract Documents. Minimize number of splices in waterstop. Splice waterstops in accordance with manufacturer's written instructions. Install factory-manufactured premolded mitered corners.

c. Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.4.2 Rubber Waterstop

Rubber waterstops must be spliced using cold bond adhesive as recommended by the manufacturer.

3.4.3 Thermoplastic Elastomeric Rubber Waterstop

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. A portable power saw must be used to miter or straight cut the ends to be joined to ensure good alignment and

contact between joined surfaces. Maintain continuity of the characteristic features of the cross section of the waterstop (for example ribs, tabular center axis, and protrusions) across the splice.

3.4.4 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

a. Unless otherwise specified, placing reinforcement and miscellaneous materials must be in accordance to ACI 301. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement.

b. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

c. Nonprestressed cast-in-place concrete members must have concrete cover for reinforcement given in the following table:

Concrete Exposure	**Member**	**Reinforcement**	**Specified cover, mm in.**
Cast against and permanently in contact with ground	All	All	75
Exposed to weather or in contact with ground	All	No. 19 through No. 57 bars	75
Not exposed to weather or in contact with ground	Slabs and walls	No. 36 bar and smaller	2~~5~~5
	Beams, columns, pedestals, and tension ties	Primary reinforcement, stirrups, ties, spirals, and hoops	50

3.5.1 General

Provide details of reinforcement that are in accordance with the Contract Documents.

3.5.2 Vapor Barrier

a. Install in accordance with ASTM E1643. Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable

to eliminate joints wherever possible. Lap joints a minimum of 300 mm and tape.

b. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier.

3.5.3 Reinforcement Supports

Provide reinforcement support in accordance with CRSI RB4.1 and ACI 301 Section 3 requirements. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 50 mm beyond the point of contact with the bars.

3.5.4 Splicing

As indicated in the Contract Documents. For splices not indicated follow ACI 301. Do not splice at points of maximum stress. Overlap welded wire reinforcement the spacing of the cross wires, plus 50 mm. AWS D1.4/D1.4M. Approve welded splices prior to use.

3.5.5 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.5.6 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.5.7 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

a. Provide fabrication tolerances that are in accordance with ACI 117.

b. Provide hooks and bends that are in accordance with the Contract Documents.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.5.8 Placing Reinforcement

Place reinforcement in accordance with ACI 301.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 25 mm from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 90 by 90 mm, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 301 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

b. Equip supports on ground and similar surfaces with sand-plates.

c. Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 1.6 mm.

d. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Contract Documents.

e. Bending of reinforcing bars partially embedded in concrete is permitted only as specified in the Contract Documents.

3.5.9 Spacing of Reinforcing Bars

a. Spacing must be as indicated in the Contract Documents.

b. Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

3.5.10 Concrete Protection for Reinforcement

Additional concrete protection must be in accordance with the Contract Documents.

3.5.11 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

In accordance with ASTM C94/C94M, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

3.6.2 Mixing

a. Mix concrete in accordance with ASTM C94/C94M, ACI 301 and ACI 304R.

b. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 29 degrees C.

c. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 29 degrees C except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and submitted water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required.

d. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

e. When fibers are used, add fibers together with the aggregates and never as the first component in the mixer. Fibers must be dispensed into the mixing system using appropriate dispensing equipment and procedure as recommended by the manufacturer.

3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.7 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5.

3.7.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 100 mm greater than indicated.

3.7.2 Pumping

ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 50 mm at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well-rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.7.3 Hot Weather

Hot weather concrete must meet the requirements of ACI 305.1 unless otherwise specified. Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 1 kg per square meter of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. If bleed water sheen is not visible on surface of unformed concrete surfaces after strikeoff and initial bull foating, provide initial curing by means of fogging or application of evaporation retarder until fnal curing method is applied. Apply evaporation retarder in accordance with manufacturer's instructions. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.4 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of

fresh concrete.

b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 22.5 liters of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1.6 mm. Deposit fresh concrete before cement grout has attained its initial set.

3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

3.8.1 Mixing Equipment

Before concrete pours, designate environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.8.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement. Use hardened, cured waste concrete as aggregate in concrete mix if approved by Contracting Officer.

3.8.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.8.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair surface defects in accordance with ACI 301 Section 5.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

Tolerances in accordance with ACI 117 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0.

Patch holes and defects in accordance with ACI 301.

3.9.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

In accordance with ACI 301 and ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where quarry tile, ceramic tile, or walk off mats are indicated. Steel trowel and fine-broom finish concrete slabs that are to receive quarry tile, ceramic tile, or paver tile. Where straightedge measurements are specified, Contractor must provide straightedge.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

3.10.1.2 Floated

Use for surfaces to receive roofing, waterproofing membranes, and exterior slabs where not otherwise specified. Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

3.10.1.3 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

3.10.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.10.1.5 Chemical-Hardener Treatment

Apply liquid-chemical floor hardener where indicated after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat must be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow to dry 24 hours between coats.

Approved proprietary chemical hardeners must be applied in accordance with manufacturer's printed directions.

3.10.1.6 Pavement

Provide as indicated on the Drawings and as specified in Section 32 13 13.06 PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES.

3.10.2 Floor Flatness and Levelness

ACI 301. Construct slabs on grade in accordance with industrial floor slab requirements listed in Section 11. ACI 117 for tolerance tested by ASTM E1155.

a. Specified Industrial:

Floor Flatness (Ff) 35 overall 20 local area minimum
Floor Levelness (FL) 25 overall 17 local area minimum

3.10.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E1155.

3.10.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

3.10.3 Concrete Walks

Provide as indicated on the Drawings and as specified in Section 32 16 19 CONCRETE SIDEWALKS.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, with dimensions as indicated on the drawings, and smooth-finished countersunk dishes sloped to drain away from the building.

3.11 JOINTS

In addition to requirements below and on the drawings, follow recommendations ACI 224.3R.

3.11.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

3.11.1.1 Maximum Allowable Construction Joint Spacing

a. In walls at not more than 18.3 meter in any horizontal direction.

b. In slabs on ground, as indicated on the Drawings.

3.11.1.2 Construction Joints for Constructability Purposes

a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 40 mm deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

3.11.2 Isolation Joints in Slabs on Ground

a. Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

b. Fill joints with premolded joint filler strips 13 mm thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 19 mm in depth where joint is sealed with sealing compound and not less than 6 mm in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.11.3 Contraction Joints in Slabs on Ground

a. Provide joints to form panels as indicated.

b. Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.

3.11.4 Sealing Joints in Slabs on Ground

a. Contraction and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete

curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

b. Sealed groove must be left ready to receive filling material that is provided as part of finish floor covering work.

c. Joints not receiving a finish flooring material must be sealed with epoxy joint filler.

3.12 CURING AND PROTECTION

Curing and protection in accordance with ACI 301 Section 5, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer, hardener, or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.12.1 Curing Periods

ACI 301 Section 5, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.12.2 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.12.3 Curing Unformed Surfaces

a. Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

b. Accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.

c. Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.12.4 Temperature of Concrete During Curing

When temperature of atmosphere is 5 degrees C and below, maintain temperature of concrete at not less than 13 degrees C throughout concrete curing period or 7 degrees C when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 27 degrees C and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 3 degrees C in any 1 hour nor 27 degrees C in any 24-hour period.

3.12.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.12.6 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.13 FIELD QUALITY CONTROL

3.13.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M or BS EN 12390-2 for making test specimens.

3.13.2 Testing

3.13.2.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders or cubes are made, and for each batch (minimum) or every 16 cubic meters (maximum) of concrete.

If a decided falling away, or shearing off, of concrete from one side or portion of the mass occurs, disregard the test and make a new test on another portion of the sample.

3.13.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 10 degrees C and above 27 degrees C) for each batch (minimum) or every 16 cubic meters (maximum) of concrete, until the specified temperature is obtained, and whenever test

cylinders or cubes and slump tests are made.

3.13.2.3 Compressive Strength Tests

ASTM C39/C39M. Make six 150 mm by 300 mm test cylinders or 150 mm cubes for each set of tests in accordance with ASTM C31/C31M or BS EN 12390-2, ASTM C172/C172M, and applicable requirements of ACI 305R and ACI 306R. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders or cubes at 7 days, two cylinders at 28 days, and hold two cylinders or cubes in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 75 cubic meters of concrete for the first 380 cubic meters, then every 380 cubic meters thereafter, nor less than once for each 500 square meters of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders or cubes from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of this section, the Contract Document, and ACI 301. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.13.2.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.13.2.5 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

a. Failure to meet compressive strength tests as evaluated.

b. Reinforcement not conforming to requirements specified.

c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.

d. Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified.

e. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

f. Poor workmanship likely to result in deficient strength.

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

3.13.2.6 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive

strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

3.13.2.7 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

a. Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

b. Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.

c. Air dry cores, (16 to 27 degrees C with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

d. Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Fill core holes solid with patching mortar or no-slump concrete of strength equal to or greater than original concrete. Finish to match adjacent concrete surfaces and moist cure for 3 days minimum.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.14 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure, the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

3.14.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.50 mm wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the Contracting Officer for approval. The

proposal must address the amount of movement expected in the crack due to temperature changes and loading.

3.14.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 6 mm thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 6 mm thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.14.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

-- End of Section --

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SECTION 03 49 00

GLASS FIBER REINFORCED CONCRETE (GFRC)
07/20

PART 1 GENERAL

1.1 DESCRIPTION

a. GFRC panel fabrication shall include all labor, materials, equipment, and related services necessary to manufacture and deliver the panels as indicated and described by the contract documents, including the following:

(1) GFRC composite panels produced by the spray-up process, including integral metal stud frame.

(2) Shop drawings and engineering calculations for panels, stud frame, and attachments to building structure.

(3) Provide loose connection hardware, and hardware for embedment in cast-in-place concrete, as indicated or required for panel attachment to building structure.

b. GFRC panel erection shall include all labor, materials, equipment, and related services necessary for the erection of the panels as indicated and described by the contract documents, including the following:

(1) Attaching all loose connection hardware between panel frames and building structural frame.

(2) Installation of mockup.

1.2 RELATED WORK

a. 03 30 00 CAST-IN-PLACE CONCRETE

b. 05 50 13 MISCELLANEOUS METAL FABRICATION

c. 07 60 00 FLASHING AND SHEET METAL

d. 07 92 00 JOINT SEALANT

e. 09 90 00 PAINTING AND COATINGS

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

MNL-128	Recommended Practice for Glass Fiber Reinforced Concrete Panels.
MNL-130-91	Manual for Quality Control for Plants and production of Glass Fiber Reinforced

Concrete Products

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C144	(2018) Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	(2018) Standard Specification for Portland Cement
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C494/C494M	(2017) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C979/C979M	(2016) Standard Specification for Pigments for Integrally Colored Concrete

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Drawings

SD-04 Samples

Finished Face

Mock-up

SD-05 Design Data

Mix Designs

Engineering Calculations

SD-06 Test Reports

Glass content by "wash-out” test

Flexural yield strength

Flexural ultimate strength

Flex anchor/gravity anchor strength

Slurry unit weight test

Slurry slump test

Aggregate gradation testing

SD-07 Certificates

Certification of Materials

SD-08 Manufacturer's Instructions

Repair and Cleaning

SD-10 Operation and Maintenance Data

Panels

SD-11 Closeout Submittals

Warranty

1.5 QUALITY CONTROL

1.5.1 Design Responsibility

Design of GFRC skin, metal frame, and connections shall be by a registered professional engineer employed or retained by the panel manufacturer and licensed to practice in state of project, using property data generated from manufacturer’s actual production. Comply with procedures in Prestressed Concrete Institute's MNL-128 and MNL-130-91. Panels shall be designed to meet all applicable local and state building codes.

1.5.2 Manufacturer Qualifications

a. Manufacturer shall have been engaged in uninterrupted production of GFRC projects involving the use of panelized GFRC of the quality and scope required for this project for a minimum of five years.

b. The GFRC manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute as Category “G”.

1.5.3 Erector Qualifications

Regularly engaged for a minimum of four years in the installation of GFRC or architectural precast concrete panels similar to those required on this project, and shall have the present erection management capability sufficient to install the required units without causing a delay of the project.

1.5.4 Erection Drawings

Shop Drawings: Manufacturer of panels shall receive all applicable drawings, specifications and related trades. Manufacturer of panels shall submit for approval complete erection drawings showing:

a. Unit shapes (elevations and sections) and dimensions

b. Thickness of facing and GFRC backing

c. Finishes

d. Steel stud frame details

e. Joint and connection details

f. Lifting and erection details

g. Location and details of hardware attached to structure

h. Size, location and details of flex and gravity anchors

i. Other items sprayed in panels

j. Handling procedures

k. Sequence of erection for special conditions

l. Relationship to adjacent material

m. Description of all loose, cast-in, and field hardware

n. Shop drawings shall be submitted in one copy sepia set. Show location of units on shop drawings by same identification marks placed on panels. Manufacturer shall not proceed with fabrication of any panels prior to receiving approval of erection drawings by the architect.

1.5.5 Engineering Calculations

Submit complete design calculations prepared and sealed by a registered engineer for typical panels including:

a. Loads used in design

b. GFRC Skin design

c. Metal stud frame design

d. Connection hardware design

e. Backup Data: Submit on request, test data on which GFRC design is based and data on GFRC insert and anchor tests.

1.5.6 Testing

Submit on request 3 copies of all test reports required. In accordance with MNL-128, and MNL-130-91, including the following:

a. Glass content by "wash-out” test

b. Flexural yield strength

c. Flexural ultimate strength

d. Flex anchor/gravity anchor strength

e. Slurry unit weight test

f. Slurry slump test

g. Aggregate gradation testing

1.5.7 Tolerances

Manufacture and install GFRC panels so that tolerances for dimensions and appearance shall be as indicated in MNL-128 and MNL-130-91.

1.5.8 Records

Keep quality control records available for two years after final acceptance.

Certification of Materials: Submit upon request, certificates of compliance with ASTM standards of all raw materials, including:

a. Aggregates

b. Admixtures

c. Fiberglass Reinforcement

d. Cement

e. Metal framing components

f. Connection Hardware

Mix Designs: Submit on request all backup and face mix designs.

1.6 WARRANTY

The GFRC contractor shall furnish a written warranty against defects in materials or workmanship for a period of one (1) year after substantial completion of project.

PART 2 PRODUCTS

2.1 GFRC MATERIALS

2.1.1 Cement

Type I, White Portland Cement of one type, brand, source and lot throughout project, meeting requirements of ASTM C150/C150M.

2.1.2 Sand

Fine, clean, dry sand, able to pass a no. 16 sieve, free of contaminants and meeting ASTM C144.

2.1.3 Water

Fresh, clean, potable and free of any deleterious matter that would interfere with color, setting or strength of concrete.

2.1.4 Glass Fibers

High zirconia content (minimum 16 percent), alkali resistant glass fibers specifically designed for use in concrete. Use 4 1/2 percent to 6 percent by weight in GFRC mix design.

2.1.5 Concrete Pigment

Harmless to concrete, sunlight-fast, alkali resistant, conforming to ASTM C979/C979M.

2.1.6 Aggregate

Clean, hard, strong, durable, inert and free of deleterious material, conforming to ASTM C33/C33M except for gradation. Size to be less than 12 mm diameter.

2.1.7 Acrylic Thermoplastic Copolymer

Conforming to the specifications in Appendix F of the Prestressed Concrete Institute MNL-128.

2.1.8 Admixtures

Conforming to ASTM C260/C260M for air entrainment, ASTM C494/C494M for chemical admixtures, and ASTM C618 for fly ash or natural pozzolan admixtures. Do not use admixtures that contain more than .1 percent chlorid ions.

2.2 PRODUCT CHARACTERISTICS

a. Typical Mixes:

(1) Combine Portland cement, glass fibers, sand and selected admixtures in proper proportions to meet design requirements.

(2) Provide glass content of no less than 4 1/2 percent and no more than 6 percent.

(3) Provide average yield strength of not less than 6 MPa and average ultimate strength of not less than 17 MPa.

b. Typical Range of GFRC Properties at 28 days:

(1) Ultimate Flexural Strength (MPa) 17-18

(2) Yield Flexural Strength (psiMPa) 6-10

(3) Ultimate Tensile Strength (MPa) 7-11

(4) Yield Tensile Strength (MPa) 5-7

(5) Compressive Strength (edgewise), (MPa) 48-83

(6) Shear Strength (interlaminar), (MPa) 3-6

(7) Shear Strength (in-plane), (MPa) 7-11

(8) Coeff. of Thermal Expansion (mmmm/ degrees C x 10) 10.8-16.2

(9) Thermal Conductivity (kcalorie/hr-meter/degrees C).....0.43-0.86

(10)Modulus of Elasticity (Gpa) 10.3-20.6

c. Facing Mix: Thickness shall generally be the minimum possible to achieve the desired finish.

d. GFRC Skin:

(1) Per skin design requirements. In no case shall the panel skin be less than 12 mm thick.

(2) Backup mixes shall have same proportion of pigments as face mixes to eliminate the possibility of bleeding through of a different colored backup.

e. Coloring Agent: The amount of coloring agent shall not exceed 10 percent of the cement weight.

2.3 FABRICATION

2.3.1 Forms

a. Forms for GFRC panels shall be rigid and constructed of materials that will result in finished products conforming to the profiles, dimensions and tolerances indicated by the contract documents and on the approved shop drawings.

b. Release agents shall be applied and used according to manufacturer's instructions. Use release agent compatible with architectural finish and joint sealants.

2.3.2 Proportioning and Mixing

a. All measurements of mix constituents shall be carried out in a careful manner to achieve the desired mix proportions.

b. The glass fiber and cement slurry shall be metered to the spray head at rates to achieve the desired mix proportion and glass content. These shall be checked in accordance with standard procedures described in MNL-130-91.

c. Cleanliness of equipment and working procedure shall be maintained at all times.

2.3.3 Hand Spray Application

a. Spray operators shall be trained personnel.

b. A mist coat consisting of the matrix without fiber may, if necessary, be sprayed onto the form. The thickness of this coating shall generally not exceed 2 mm in order to avoid an unreinforced surface.

c. Spray-up of the main body of material shall proceed before any mist coat or facing mix has set.

d. Application shall be by spraying such that uniform thickness and distribution of glass fiber and cement matrix is achieved during the

application process.

e. Consolidation shall be by rolling or such other techniques as necessary to achieve complete encapsulation of fibers and compaction.

f. Control of thickness shall be achieved by using a pin gauge or other approved method. A minimum of one measurement per each 5 square feet of panel surface shall be made.

g. All hand-forming of intricate details, incorporation of formers or infill material, and over-spraying shall be carried out before the material has achieved its initial set so as to ensure complete bonding.

2.3.4 Inserts and Embedments

a. Inserts shall be properly embedded in built-up homogeneous GFRC bosses or bonding pads to develop their strength. Waste material such as over-spray is not acceptable to encapsulate inserts or for bonding pads.

b. Rigid embedded items bonded to the GFRC shall not create undesirable restraint to volume changes.

2.3.5 Steel Stud Frame System

a. Steel stud frame shall be a prefabricated welded frame produced in accordance with the approved erection drawings.

b. All accessible welds shall be touched up after welding.

2.3.6 Allowable Tolerances

Manufacture units so that each panel complies with the dimensional tolerances listed below. For dimensional tolerances not listed below, those listed in MNL-130-91, shall apply.

Dimensional Tolerances of Finished Units:

a. Overall height and width of units measured at the face adjacent to the form:

(1) 3 m or under.....± 3 mm

(2) 3 m and over.....± 3 mm

b. Thickness:

(1) Skin thickness: .....± 6 mm, -0 mm

(2) Architectural facing thickness: .....± 3 mm, -0 mm

(3) Side return thickness:..... ± 12 mm, -0 mm

(4) Panel depth from face of skin to back of steel stud or integral rib: .....± 9 mm, 6 mm

c. Angular variation of plane of side mold: 1 mm per 75 mm depth or 1.5 mm total, whichever is greater.

d. Variation from square or designated skew (difference in length of the two diagonal measurements): 3 mm per 1.8 m or 6 mm total, whichever is greater.

e. Length and width of blockouts and openings within one unit: ± 6 mm

f. Position Tolerances (measured from datum line locations as shown on the approved erection drawings):

(1) Steel studs and tracks: ± 6 mm

(2) Flashing reglets, at edge of panel ± 6 mm

(3) Reglets for glazing gaskets ± 3 mm

2.3.7 Finishes

Exposed face of panels to match approved sample on file in architect's office. Exposed face of panels shall be manufactured free from joint marks, "grain" or other obvious defects.

2.3.8 Cover

Provide embedded anchors, inserts, and other sprayed-in items with sufficient anchorage and embedment for design requirements.

2.3.9 Curing

a. Immediately after the completion of spraying of the panel, a curing method shall be used to ensure sufficient strength for removing the units from the form.

b. After initial curing, remove panel from form and place in a controlled curing environment. Panels shall be kept continuously wet for a minimum of 7 days in accordance with manufacturer’s standard curing practice. The temperature shall be maintained between 15 degrees C and 49 degrees C during this period. In lieu of moist curing, acrylic thermoplastic copolymer dispersion shall be used as a curing admixture. Only copolymers shown to eliminate the need for moist curing through published independent laboratory test data shall be used.

2.3.10 Panel identification

a. Mark each GFRC panel to correspond to identification marks on shop drawings for panel location.

b. Mark each GFRC panel with date cast.

2.3.11 Acceptance

GFRC units which do not meet the color and texture range or the dimensional tolerances may be rejected at the option of the architect if they cannot be satisfactorily corrected.

PART 3 EXECUTION

3.1 PRE-INSTALLATION/INSPECTION

3.1.1 Preinstallation Conference

Prior to installation of work of this section, conduct a meeting at the project site to discuss quality assurance requirements. In addition to the contractor and the installer, arrange for attendance of the following:

a. Other installers affected by the work of this section

b. The Owner's representative

c. Manufacturer's representative

3.1.2 General Contractor

a. Provide building lines, center and grades in sufficient detail to allow installation of the GFRC units.

b. Provide true, level load-bearing surfaces.

c. Provide for the accurate placement and alignment of anchor bolts, plates, dowels or other items embedded in the concrete structure or that are a part of the structural building frame.

d. Clear, well-drained unloading areas and road access around and in the building shall be provided and maintained by to a degree that hauling and erection equipment for the GFRC units are able to operate under their own power.

e. Provide adequate traffic control, barricades, warning lights or signs to safeguard traffic in the immediate area of hoisting and handling operations.

3.1.3 Erector

a. Verify that all parts of the supporting structure are complete and ready to receive the panels and that site conditions are conducive to proper installation.

b. Prior to installation of the units, check the jobsite dimensions affecting the work under his contract. Any discrepancies between design dimensions and field dimensions which could adversely affect installation shall be brought to the attention of the general contractor.

c. If discrepancies exist, installation shall not proceed until they are corrected or until installation requirements are modified and reviewed by the Owner's Representative.

3.2 DELIVERY, STORAGE AND HANDLING

3.2.1 Delivery and Handling

a. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses or damage.

b. Lift or support units only at the points shown on the erection shop drawings.

c. Place non-staining resilient spacers of even thickness between units.

d. Support units during shipment on non-staining shock-absorbing material.

e. Protect units from dirt and damage during handling and transport.

3.2.2 Storage at Jobsite

a. Store units to protect them from contact with soil, staining and from physical damage.

b. Store units, unless otherwise specified, with non-staining, resilient supports located in same positions as when transported.

c. Store units on firm, level and smooth surface.

d. Place stored units so that identification marks are easily readable.

3.3 INSTALLATION OF PANELS

Only competent workmen who are properly instructed to handle and erect GFRC shall be employed.

Prior to commencement of manufacture, submit samples representative of finished face showing typical range of color and texture. Sample size shall be approximately 30 cm by 30 cm and of appropriate thickness, representative of the proposed finished product.

Mock-up: Prior to installation of the work of this section, erect a sample at location directed by or acceptable to the architect, using specified materials and illustrating range of color, texture and workmanship to be expected in the completed work. Once mock-up has been approved by the architect, retain until the work has been completed and accepted.

3.3.1 Setting

a. GFRC units shall be lifted with suitable lifting devices at points provided by the manufacturer.

b. GFRC units shall be set level, plumb, square and true within allowable tolerances.

c. Panel-to-panel joints shall be a minimum of 12 mm.

3.3.2 Supports and Bracing

The erector shall provide temporary supports and bracing as required to maintain position, stability and alignment as units are being connected.

3.3.3 Fastening

a. Fasten GFRC units in place by bolting or welding or both as shown on the approved erection drawings.

b. Field welding shall be done by qualified welders using equipment and materials compatible to the base material.

c. Shall be completely free and independent of adjacent materials.

3.3.4 Tolerances of Erected Units

Tolerances for location of GFRC units shall be noncumulative and as listed below. For erection tolerances not listed below, those listed in MNL-130-91 shall apply.

Tolerance for Face Width of Joint:

Panel dimension 3 m. or less .....± 5 mm
Panel dimension 3 to 6 m.....± 6 mm
Panel dimension greater than 6 m.....± 8 mm

3.3.5 Warpage

Maximum permissible warpage of one corner out of the plane of the other three shall be 5 mm per meter distance from the nearest adjacent corner, or 6 mm total after installation.

3.3.6 Bowing

Not over L/360 with a maximum of 25 mm, where L is the panel length in the direction of the bow. Differential bowing as erected between adjacent members of the same design shall be 6 mm.

3.3.7 Repair And Cleaning

Submit procedure and patch mix design for repairing and/or cleaning panels.

3.4 PATCHING

3.4.1 Method

Mix and place patch mixture to match color and texture of surrounding concrete. If patching is not possible or if unacceptable, GFRC unit is to be replaced.

3.4.2 Structural Adequacy

Patching will be permitted provided structural adequacy of the unit is not impaired.

3.4.3 Damage

damage caused by other trades that requires replacement or patching shall be performed by the GFRC manufacturer and paid for by others after written authorization to perform said work.

3.5 CLEANING

a. Cleaning methods shall be approved by fabricator.

b. After installation, the manufacturer shall clean any soiled GFRC surfaces with detergent and water, using fiber brush and sponge, and rinse thoroughly with clean water.

c. Use extreme care to prevent damage to GFRC surfaces and to adjacent

materials.

d. Soiled surfaces must be thoroughly rinsed with clean water immediately after using cleaner.

3.6 PROTECTION OF WORK

a. The erector shall be responsible for protection of the panels from damage by the erection crews, field welding or cutting operations by providing non-combustible shields as necessary during these operations.

b. The erector shall be responsible for any chipping, spalling, cracking or other damage to the units after delivery to the jobsite unless damage is caused by others during site storage.

3.7 INSPECTION AND ACCEPTANCE

3.7.1 Acceptance

Final inspection and acceptance of erected GFRC panels shall be made to verify conformance with plans and specifications.

3.7.2 Rejection

Panels may be rejected for any one of the following product defects or installation deficiencies remaining after repairs and cleaning have been accomplished. "Visible" means visible to a person with normal eyesight when viewed from a distance of 6 m in broad daylight.

a. Nonconformance to specified tolerances

b. Air voids (bug-holes or blowholes) larger than 10 mm in diameter

c. Visible casting lines

d. Visible form joints

e. Visible irregularities

f. Visible stains on panel surface

g. Visible differences between panel and approved sample

h. Visible non-uniformity of textures or color

i. Visible areas of backup concrete bleeding through the facing concrete

j. Visible foreign material embedded in the face

k. Visible repairs or cracks

l. Visible reinforcement shadow lines

-- End of Section --

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SECTION 04 20 00

UNIT MASONRY
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318M	(2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A641/A641M	(2009a; R 2014) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by

	the Hot-Dip Process
ASTM A951/A951M	(2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C1019	(2018) Standard Test Method for Sampling and Testing Grout
ASTM C129	(2017) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars
ASTM C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270	(2014a) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2018) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2017) Standard Specification for Chemical Admixtures for Concrete
ASTM C641	(2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C90	(2016) Standard Specification for Loadbearing Concrete Masonry Units
ASTM C979/C979M	(2016) Standard Specification for Pigments for Integrally Colored Concrete
ASTM D2000	(2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2287	(2012) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

THE MASONRY SOCIETY (TMS)

TMS MSJC	(2016) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements and Specification for Masonry Structures, Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries

1.2 SUBMITTALS

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SD-02 Shop Drawings

Reinforcement Detail Drawings; G M

SD-03 Product Data

Hot Weather Procedures

Cementitious Materials

SD-04 Samples

Mock-Up Panel; G R

Concrete Masonry Units (CMU); G R

Admixtures for Masonry Mortar; G R

Anchors, Ties, and Bar Positioners; G R

Joint Reinforcement; G R

Insulation; G R

SD-05 Design Data

Masonry Compressive Strength; G M

Bracing Calculations; G M

SD-06 Test Reports

Field Testing of Grout; G R

SD-07 Certificates

Concrete Masonry Units (CMU)

Precast Concrete Units

Cementitious Materials

Admixtures for Masonry Mortar

Admixtures for Grout

Anchors, Ties, and Bar Positioners

Joint Reinforcement

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar

Admixtures for Grout

1.3 QUALITY ASSURANCE

1.3.1 Masonry Mock-Up Panels

1.3.1.1 Mock-Up Panel Location

After material samples are approved and prior to starting masonry work, construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the Contracting Officer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

1.3.1.2 Mock-Up Panel Configuration

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. Provide a straight panel or a leg of an L-shaped panel of minimum size 2.5 m long by 1.8 m high.

1.3.1.3 Mock-Up Panel Composition

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. Include a masonry bonded corner and parging and installation of electrical boxes and conduit. When the panel represents reinforced masonry, include a 610 by 610 mm opening placed at least 610 mm above the panel base and 610 mm away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

1.3.1.4 Mock-Up Panel Construction Method

Where anchored veneer walls or cavity walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Demonstrate provisions to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. When water-repellent is specified to be applied to the masonry, apply the approved product to the mock-up panel. Construct panels on a properly

designed concrete foundation.

1.3.1.5 Mock-Up Panel Purpose

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved. Perform cleaning procedures on the mockup and obtain approval of the Contracting Officer prior to cleaning the building. After completion of the work, completely remove the mock-up panels, including all foundation concrete, from the construction site.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

a. Pack concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 38 degrees C, or exceeds 32 degrees C and the wind velocity is greater than 13 km/h, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, f'm, is 14.0 MPa.

2.1.2 Performance - Verify Masonry Compressive Strength

Verify specified compressive strength of masonry using the "Unit Strength Method" of TMS MSJC. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used. Submit test results.

2.2 MANUFACTURED UNITS

2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2.2 Concrete Units

2.2.2.1 Aggregates

Test lightweight aggregates, and blends of lightweight and heavier aggregates in proportions used in producing the units, for stain-producing iron compounds in accordance with ASTM C641,visual classification method. Do not incorporate aggregates for which the iron stain deposited on the filter paper exceeds the "light stain" classification.

2.2.2.2 Concrete Masonry Units (CMU)

2.2.2.2.1 Cement

Use only cement that has a low alkali content and is of one brand.

2.2.2.2.2 Recycled Content

Units may contain post-consumer or post-industrial recycled content.

2.2.2.2.3 Size

Provide units with specified dimension of 200 mm wide, 200 mm high, and 400 mm long (for primary wall).

Provide units with specified dimension of 100 mm wide, 200 mm high, and 400 mm long (for veneer).

2.2.2.2.4 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather.

2.2.2.2.5 Unit Types

a. Hollow Load-Bearing Units: ASTM C90, medium weight. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C129, medium weight. Load-bearing units may be provided in lieu of non-load-bearing units.

2.2.2.2.6 Jamb Units

Provide jamb units of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

Provide sash jamb units with a 19 by 19 mm groove near the center at end of each unit.

2.2.2.3 Architectural Units

Provide architectural units with patterned face shell: Split ribbed with a four rib configuration. Cmu split ribbed block profile, texture, mortar color to match the existing split ribbed on site.

Provide units that are integrally colored during manufacture, with color FS 20400.

2.2.2.4 Patterned, Decorative Screen Units

Provide Vernacular A patterned, decorative screen units as indicated on the Drawings that conform to ASTM C90. Provide units that have uniform through-the-wall pattern, color, and texture.

2.2.3 Precast Concrete Units

2.2.3.1 General

a. Provide precast concrete, lintels, that are factory-made units in a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, provide precast concrete with minimum 28 MPa compressive strength, conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 13 mm to No. 4 nominal-size coarse aggregate, and with reinforcement required for handling of the units. Maintain minimum clearance of 19 mm between reinforcement and faces of units.

b. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 827 kPa for at least 5 hours, either damp-cure for 24 hours or steam-cure and then age under cover for 28 days or longer. In precast concrete members weighing over 35 kg provide built-in loops of galvanized wire or other approved provisions for lifting and anchoring.

c. Fabricate units with beds and joints at right angles to the face, with sharp true arises and with drip grooves on the underside where units

overhang walls. Form exposed-to-view surfaces free of surface voids, spalls, cracks, and chipped or broken edges and with uniform appearance and color. Unless otherwise specified, provide units with a smooth dense finish.

d. Prior to installation, wet and inspect each unit for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

e. Submit specified factory certificates.

2.2.3.2 Precast Concrete Lintels

Provide precast concrete lintels, unless otherwise shown, of a thickness equal to the wall and reinforced with minimum two No. 4 bars for the full length. Provide top and bottom bars for lintels over 914 mm in length. Provide at least 200 mm bearing at each end. Label the top of lintels and clearly mark each lintel to show location in the structure. Design reinforced lintels in conformance with ACI 318M for flexural and shear strength, using concrete with a minimum 28 day compressive strength of 21 MPa. Limit lintel deflection due to dead plus live load to L/600 or 7.6 mm.

2.2.3.3 Precast Concrete Sills

Cast sills washes. For windows having mullions, cast sills in sections with head joints at mullions and a 6 mm allowance for mortar joints. Roughen the ends of sills, except a 19 mm wide margin at exposed surfaces, for bond. Provide rounded nosings on treads of door sills. Reinforce sills with not less than two No. 12 bars.

2.3 EQUIPMENT

2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

2.4 MATERIALS

2.4.1 Mortar Materials

2.4.1.1 Cementitious Materials

Provide cementitious materials that conform to those permitted by ASTM C270.

2.4.1.2 Hydrated Lime and Alternates

Provide lime that conforms to one of the materials permitted by ASTM C207 for use in combination with portland cement, hydraulic cement, and blended hydraulic cement. Do not use lime in combination with masonry cement or mortar cement.

2.4.1.3 Colored Mortar

Use mortar pigment that conforms to ASTM C979/C979M. Add pigment to mortar to produce a uniform color matching FS 20400. Furnish pigments in

accurately pre-measured and packaged units that can be added to a measured amount of cementitious materials or supply pigments via preblended cementitious materials or dry mortar mix.

a. In masonry cement or mortar cement, do not exceed 5 percent of cement weight for mineral oxide pigment; do not exceed 1 percent of cement weight for carbon black pigment.

b. In cement-lime mortar mix, do not exceed 10 percent of cementitious materials' weight for mineral oxide pigment; do not exceed 2 percent of cementitious materials' weight for carbon black pigment.

2.4.1.4 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III Portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to ASTM C1384. Provide a water-repellent admixture, conforming to ASTM C1384 and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

2.4.1.5 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by ASTM C270.

2.4.2 Grout and Ready-Mix Grout Materials

2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by ASTM C476.

2.4.2.2 Admixtures for Grout

Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.

2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by ASTM C476.

2.5 MORTAR AND GROUT MIXES

2.5.1 Mortar Mix

a. Provide mortar Type S unless specified otherwise herein. Do not use masonry cement in the mortar.

b. Provide mortar that conforms to ASTM C270.

c. For field-batched mortar, measure component materials by volume. Use measuring boxes for materials that do not come in packages, such as sand, for consistent batching. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar unless approved by the Contracting Officer. Maintain workability of mortar by remixing or retempering. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

d. For preblended mortar, follow manufacturer's mixing instructions.

2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to ASTM C476, fine. Use conventional grout with a slump between 203 and 279 mm. Use self-consolidating grout with slump flow of 610 to 762 mm and a visual stability index (VSI) not greater than 1. Provide minimum grout strength of 14 MPa in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

2.6 ACCESSORIES

2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

2.6.2 Anchors, Ties, and Bar Positioners

2.6.2.1 General

a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 16 mm mortar cover from each face of masonry.

b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.

c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.

d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.

e. Submit two anchors, ties and bar positioners of each type used, as samples.

2.6.2.2 Wire Mesh Anchors

Provide wire mesh anchors of 6 mm mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 305 mm, at intersections of interior non-bearing masonry walls.

2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction

Provide rectangular-shaped wall ties, fabricated of hot-dipped galvanized MW18 diameter steel wire. Provide rectangular wall ties no less than 100 mm wide.

Provide adjustable type wall ties, if approved for use, that consist of two essentially U-shaped elements fabricated of minimum MW18 diameter steel wire or pintle type ties that are inserted to eyes of horizontal joint reinforcement, hot-dip galvanized. Provide adjustable ties with double pintle legs and allows a maximum offset of 32 mm between each element of the tie and maximum distance between connecting parts no more than 2 mm. Form the pintle and eye elements shall be formed so that both can be in the same plane. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT.

2.6.2.4 Dovetail Anchors

Provide dovetail anchors of 5 mm diameter steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. Use these anchors to connect the exterior masonry wythe as it passes over the face of concrete columns, beams, or walls. Fill cells immediately above and below these anchors unless solid units are used. Furnish dovetail slots, which are specified to be installed by others, in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.6.2.5 Adjustable Anchors

2.6.2.5.1 Anchorage to Structural Steel

Provide hot-dip galvanized adjustable anchors for connecting masonry walls to the structural steel frame as detailed on the drawings. Provide zinc-rich paint for touching up paint after welding galvanized anchors to structural steel.

2.6.2.5.2 Anchorage of Veneer to Light Gauge Steel or Concrete Backing

Use one of the following types of adjustable anchors to connect veneer to light gauge steel or concrete backing:

a. sheet metal at least 22 mm wide, 1.5 mm thick, and with corrugations having a wavelength of 7.6 to 12.7 mm and an amplitude of 1.5 to 2.5 mm or bent, notched or punched to provide equivalent performance;

b. wire anchors of minimum size MW11 with ends bent to form a minimum 50 mm extension and without drips;

c. or wire pintle anchors used in conjunction with joint reinforcement.

Do not exceed 1.6 mm clearance between connecting parts of the tie. Assemble adjustable anchors to prevent disengagement. Provide pintle anchors with one or more pintle legs of wire size MW18 and an offset not

exceeding 32 mm.

2.6.2.6 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized.

2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9-gauge. Size joint reinforcement to provide a minimum of 16 mm cover from each face. Space crosswires not more than 400 mm. Provide joint reinforcement for straight runs in flat sections not less than 3 m long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60.

2.6.5 Concrete Masonry Control Joint Keys

Provide control joint keys of a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 16 mm thick and 10 mm thick flanges, with a tolerance of plus or minus 1.5 mm, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

2.6.6 Through Wall Flashing and Weeps

2.6.6.1 General

Provide stainless steel sheet flashing.

2.6.6.2 Stainless Steel Flashing

Provide stainless steel, ASTM A167, Type 304 or 316, 0.4 mm thick, No. 2D finish. Where indicated, provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions, where deformations consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

2.6.6.3 Weep Ventilators

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges

to fit in a standard 10 mm wide mortar joint and with height equal to the nominal height of the unit.

2.6.6.4 Metal Drip Edge

Provide stainless steel drip edge, 0.4 mm thick, hemmed edges, with down-turned drip at the outside edge and upturned dam at the inside edge for use with membrane flashings.

2.6.7 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as specified in Section 07 21 13 BOARD AND BLOCK INSULATION.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 3 mm. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

3.3.1 General

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in stacked bond pattern. Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus 13 mm. Adjust each unit to its final position while mortar is still soft and has plastic consistency.

b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.

c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Toothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of down on each side of the wall and hold securely in place.

d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 13 mm into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.

e. In multi-wythe construction with collar joints no more than 20 mm wide, bring up the inner wythe not more than 400 mm ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces concave, using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint. No exterior joints are to be left un-tooled.

3.3.1.1.2 Flush Joints

Flush cut mortar joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas. Finish flush cut joints by cutting off the mortar flush with the face of the wall. Point joints in unparged masonry walls below grade tight. For architectural units, such as fluted units, completely fill both the head and bed joints and flush cut.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm.

3.3.1.1.4 Joint Widths

a. Provide 10 mm wide mortar joints in concrete masonry, except for prefaced concrete masonry units.

b. Maintain mortar joint widths within tolerances permitted by TMS MSJC

3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 300 mm wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

3.3.1.3 Unfinished Work

Rack back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved by the Contracting Officer. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.3.1.4 Control Joints

Provide control joints in concrete masonry as indicated. Construct in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating courses on each side of the joint. Interrupt the control joint key in courses containing continuous

bond beam reinforcement. Do not interrupt the horizontal reinforcement and grout at the control joint.

Where mortar was placed in the joint, rake both faces of the control joints to a depth of 19 mm. Install backer rod and sealant on both faces in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.1.5 Decorative Architectural Units

Place decorative masonry units with the patterned face shell properly aligned in the completed wall.

3.3.2 Cavity Walls (Multi-Wythe)

Provide a continuous cavity as indicated. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. At the bottom of cavity walls, in the course immediately above the through-wall flashing, temporarily omit one brick every 1200 mm. Clean mortar droppings and debris out of the cavity through the temporary openings at least once each day masonry is laid, and more often when required to keep the cavities clean. Fill in the openings with bricks and mortar after the wall is complete and the cavity has been inspected and found clean. Dampproof cavity face of interior wythe in accordance with Section 07 11 13 BITUMINOUS DAMPPROOFING.

Securely tie the two wythes together with horizontal joint reinforcement, or provide ties to connect the masonry wythes in sufficient quantity. Provide additional ties around openings larger than 405 mm in either direction. Space ties around perimeter of opening at a maximum of 910 mm on center. Place ties within 305 mmof openings. Ties with drips are not permitted.

3.3.3 ANCHORAGE

3.3.3.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm on centers vertically and 600 mm on center horizontally.

3.3.3.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 400 mm on centers vertically, and if applicable, not over 600 mm on centers horizontally.

3.3.3.3 Anchorage at Intersecting Walls

Provide wire mesh anchors at maximum 400 mm spacing at intersections of interior non-bearing masonry walls.

3.3.4 Lintels

3.3.4.1 Precast Concrete

Provide precast concrete as shown on the Drawings. Set lintels in a full bed of mortar with faces plumb and true. Provide precast lintels with a minimum bearing length of 200 mm unless otherwise indicated. In partially

grouted masonry, provide fully grouted units under the full lintel bearing length, unless otherwise indicated.

3.3.5 Sills and Copings

Set sills and copings in a full bed of mortar with faces plumb and true. Slope sills and copings to drain water. Mechanically anchor copings and sills longer than 1200 mm as indicated.

3.4 INSTALLATION

3.4.1 Bar Reinforcement Installation

3.4.1.1 Preparation

Submit detail drawings showing bar splice locations. Identify bent bars on a bending diagram and reference and locate such bars on the drawings. Show wall dimensions, bar clearances, and wall openings. Utilize bending details that conform to the requirements of ACI SP-66. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, resubmit the approved shop drawings with the additional openings shown along with the proposed changes. Clearly highlight location of these additional openings. Provide wall elevation drawings with minimum scale of 1 to 50. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, and other coatings that might destroy or reduce its bond prior to placing grout. Do not use bars with kinks or bends not shown on the approved shop drawings. Place reinforcement prior to grouting. Unless otherwise indicated, extend vertical wall reinforcement to within 50 mm of tops of walls.

3.4.1.2 Positioning Bars

a. Accurately place vertical bars within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of13 mm between the bars and masonry units for coarse grout and a minimum clearance of 6 mm between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 25 mm or one diameter of the reinforcement, whichever is greater. Vertical reinforcement may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement or by other means to prevent displacement beyond permitted tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.

b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.

c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.

d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent when permitted by TMS MSJC.

3.4.1.3 Splices of Bar Reinforcement

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified yield strength of the reinforcement.

3.4.2 Placing Grout

3.4.2.1 General

Fill cells containing reinforcing bars with grout. Solidly grout hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls

In multi-wythe composite walls, provide grout barriers in the collar join not more than 9 m apart, or as required, to limit the horizontal flow of grout for each pour.

3.4.2.3 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.2.4 Grout Holes and Cleanouts

3.4.2.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 400 mm on centers where grouting of hollow unit masonry is indicated. Fom such openings not less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units. provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of the grout pour exceeds 1.6 m. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 800 mm where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Provide cleanouts not less than 75 by 75 mm by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction

Provide cleanouts for construction of walls that incorporate a grout filled cavity between solid masonry wythes, provide cleanouts at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.5 Grout Placement

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 13 mm or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 1.6 m. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.

b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.

c. If the masonry has cured at least 4 hours, grout slump is maintained between 250 and 275 mm, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 3.9 m. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 1.6 m above the bottom of the lift, but do not exceed 3.9 m. If masonry has not cured at least 4 hours or grout slump is not maintained between 250 and 275 mm, place conventional grout in lifts not exceeding 1.6 m.

d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 300 mm or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 300 mm in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 38 mm below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.

e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 1.6 m. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.

f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.3 Joint Reinforcement Installation

Install joint reinforcement at 400 mm on center unless otherwise indicated. Lap joint reinforcement not less than 150 mm. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 16 mm cover to either face of the unit.

3.4.4 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.4.5 Flashing and Weeps

a. Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by lapping a minimum of 150 mm under the weather resistive barrier.

b. Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of open head joints. Locate weeps not more than 600 mm on centers in mortar joints of the exterior wythe directly on the

horizontal leg of through-wall flashing over foundations, bond beams, and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to406 mm on center and approved by the Contracting Officer. Maintain weeps free of mortar and other obstructions.

3.5 APPLICATION

3.5.1 Insulation

Insulate cavity walls (multi-wythe noncomposite masonry walls), where shown, by installing board-type insulation on the cavity side of the inner wythe. Apply board type insulation directly to the masonry or thru-wall flashing with adhesive. Neatly fit insulation between obstructions without impaling insulation on ties or anchors. Apply insulation in parallel courses with vertical joints breaking midway over the course below and in moderate contact with adjoining units without forcing. Cut to fit neatly against adjoining surfaces. Tape or seal the joints between the boards.

3.5.2 Interface with Other Products

3.5.2.1 Built-In Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

3.5.2.2 Door and Window Frame Joints

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of 10 mm.

3.5.2.3 Bearing Plates

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Provide bedding mortar and non-shrink grout s specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5.3 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

3.6.1.1 Field Testing of Grout

a. Perform grout testing at the following frequency: 1 time per every 450 square meters of wall area. For each required grout property to

be evaluated, provide a minimum of three specimens.

b. Sample and test conventional and self-consolidating grout for compressive strength and temperature in accordance with ASTM C1019.

c. Evaluate slump in conventional grout in accordance with ASTM C1019.

d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with ASTM C1611/C1611M.

3.7 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.8 CLOSE-OUT TAKE-BACK PROGRAM

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial, scrap, packaging to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 600 mm down on each side of the wall and hold securely in place. Before starting or resuming work, clean top surface of masonry in place of loose mortar and foreign material.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING
05/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	(2012) North American Specification for the Design of Cold-Formed Steel Structural Members
AISI S110	(2007; Suppl 1; Reaffirmed 2012) Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames
AISI S200	(2007) North American Standard for Cold-Formed Steel Framing - General Provision
AISI S201	(2007) North American Standard for Cold-Formed Steel Framing - Product Data
AISI S202	(2011) Code of Standard Practice for Cold-formed Steel Structural Framing
AISI S211	(2007) North American Standard for Cold-Formed Steel Framing - Wall Stud Design
AISI S212	(2007) North American Standard for Cold-Formed Steel Framing - Header Design
AISI S213	(2007; Suppl 1 2009) North American Standard for Cold-Formed Steel Framing - Lateral Design

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2011) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1003/A1003M	(2015) Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A370	(2017a) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C1007	(2011a) Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM C1513	(2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM C955	(2017) Standard Specification for Cold-Formed Steel Structural Framing Members
ASTM E119	(2019) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E329	(2018) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1941	(2010) Standard Specification for Electrodeposited Coatings on Threaded

	Fasteners (Unified Inch Screw Threads (UN/UNR))
ASTM F2329/F2329M	(2015) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2015) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2013; with Change 4, 2018) Structural Engineering

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00.

SD-02 Shop Drawings

Framing Components; G M

SD-03 Product Data

Steel Studs, Joists, Tracks, Bracing, Bridging and Accessories

Recycled Content of Steel Products

SD-05 Design Data

Metal Framing Calculations; G M

SD-07 Certificates

Cold-Formed Metal Framing

Welds

1.3 DELIVERY, STORAGE, AND HANDLING

Steel framing and related accessories shall be stored and handled in accordance with the AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".

1.4 COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI S100. Furring, miscellaneous

supports are specified in Section 09 22 00 SUPPORTS FOR PLASTER AND GYPSUM BOARD.

Submit mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

1.5 MAXIMUM DEFLECTION

Deflections of structural members shall not exceed the more restrictive of the limitations of ICC IBC and UFC 3-301-01.

1.6 QUALITY ASSURANCE

a. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a registered professional engineer.

b. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 for testing indicated.

c. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

d. Welding Qualifications: Qualify procedures and personnel according to the following:

(1) AWS D1.1/D1.1M, "Structural Welding Code - Steel".

(2) AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".

e. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.

f. AISI Specifications and Standards: Comply with:

(1) AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members".

(2) AISI S110, "Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames".

(3) AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provision".

(4) AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Data".

(5) AISI S202, "Code of Standard Practice for Cold-Formed Steel

Structural Framing".

(6) AISI S211, "North American Standard for Cold-Formed Steel Framing - Wall Stud Design".

(7) AISI S212, "North American Standard for Cold-Formed Steel Framing - Header Design".

(8) AISI S213, "North American Standard for Cold-Formed Steel Framing - Lateral Design".

1.6.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories including the following:

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

Sign and seal fabrication drawings by a registered professional engineer.

1.6.2 Design Data Required

Submit metal framing calculations with design criteria and structural loading to verify sizes, thickness, and spacing of members and connections signed and sealed by a registered professional engineer. Show methods and practices used in installation.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C955 and the following.

a. Provide products with an average recycled content of steel products so postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.

b. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

(1) Grade: As required by structural performance.

(2) Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

c. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

(1) Minimum Base-Metal Thickness: 0.84 mm.

(2) Flange Width: 35 mm.

d. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

(1) Minimum Base-Metal Thickness: Matching steel studs.

(2) Flange Width: 32 mm.

2.1.1 Studs and Joists of 1.37 mm and Heavier

Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50, Z180.

2.1.2 Studs and Joists of 1.09 mm and Lighter

Studs and Joists of 1.09 mm and Lighter, Track, and Accessories (All thicknesses): Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS, Grade 345 230 MPa Z180.

2.1.3 Sizes, Thickness, Section Modulus, and Other Structural Properties

Size and thickness as required, unless noted on Drawings.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 1200 mm on center and shall be legible and easily read. The product marking shall include the following:

a. An ICC number.

b. Manufacturer's identification.

c. Minimum delivered uncoated steel thickness.

d. Protective coating designator.

e. Minimum yield strength.

2.3 CONNECTIONS

2.3.1 Steel-To-Concrete Connections

a. Anchor Rods: ASTM F1554, Grade 240; galvanized per ASTM A153/A153M.

b. Post-Installed Concrete Anchors: Adhesive or expansion anchors fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.

c. Powder-Actuated Fasteners: Fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC 70 greater than or equal to the design load as determined by testing per ASTM E1190 conducted by a qualified testing agency.

2.3.2 Steel-To-Steel Connections

a. Screws: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel screws of the type and size indicated. Provide low-profile head beneath sheathing and manufacturer's standard elsewhere. Electroplated to a minimum of 5 micron zinc coating per ASTM F1941 or hot-dipped galvanized per ASTM A123/A123M or ASTM A153/A153M.

b. Bolts: ASTM A307 coated by hot-dip process per ASTM F2329/F2329M or zinc-coated by mechanical-deposition process per ASTM B695, Class 55.

c. Welding Electrodes: Comply with AWS standards.

2.4 PLASTIC GROMMETS

Supply plastic grommets for stud webs as recommended by stud manufacturer, to protect electrical wires and plumbing piping. Prevent metal-to-metal contact between wiring/piping and studs.

2.5 SEALER GASKET

Closed-cell neoprene foam, 6.4 mm thick, selected from manufacturer's standard widths to match width of bottom track on concrete slab or foundation.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by welding or by using self-drilling, self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.1.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI S100. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3/D1.3M. Submit certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 1.09 mm.

3.1.2 Screws

Screws shall be of the self-drilling self-tapping type, size, and location as required, unless noted on Drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI S100. Screws covered by sheathing materials shall have low profile heads.

3.1.3 Anchors

Anchors shall be of the type, size, and location as required.

3.1.4 Powder-Actuated Fasteners

Powder-actuated fasteners shall be of the type, size, and location as

required.

3.2 INSTALLATION

Install cold-formed framing in accordance with ASTM C1007 and AISI S200.

Install cold-formed steel framing according to AISI S202 and to manufacturer's written instructions unless more stringent requirements are indicated.

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of studs. Install sealer gasket under bottom of track on concrete slab or foundation. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 75 mm from the edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 600 mm wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. Provide horizontal bracing in accordance with the design calculations and AISI S100. Bracing shall be not less than the following:

LOAD	HEIGHT	BRACING
Wind load only	Up to 3000 mm 10 feet	One row at mid-height
	Over 3000 mm 10 feet	Rows 1500 mm 5'-0" o.c. maximum
Axial load	Up to 3000 mm 10 feet	Two rows at 1/3 points
	Over 3000 mm 10 feet	Rows 900 mm 3'-4" o.c. maximum

3.2.3 Joists

a. Provide a stud directly under each joist. The maximum spacing of studs as indicated shall be maintained. Trusses bear directly on concrete roof slab.

b. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

3.2.4 Erection Tolerances

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

(1) Layout of walls and partitions: 6 mm from intended position;

(2) Plates and runners: 6 mm in 2400 mm from a straight line;

(3) Studs: 6 mm in 2400 mm out of plumb, not cumulative; and

(4) Face of framing members: 6 mm in 2400 mm from a true plane.

-- End of Section --

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SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2016) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.3	(2013) Safety Requirements for Powder-Actuated Fastening Systems American National Standard for Construction and Demolition Operations

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2011) Structural Welding Code - Steel
AWS D1.6/D1.6M	(2017) Structural Welding Code - Stainless Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.21.2M	(1999; R 2014) Lock Washers (Metric Series)
ASME B18.22M	(1981; R 2017) Metric Plain Washers
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series

ASME B18.6.3	(2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A108	(2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A240/A240M	(2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276	(2010) Standard Specification for Stainless Steel Bars and Shapes
ASTM A29/A29M	(2016) Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	(2018) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A554	(2016) Standard Specification for Welded Stainless Steel Mechanical Tubing
ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of

	Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2018) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/B108M	(2015) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C1513	(2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
MASTER PAINTERS INSTITUTE (MPI)	
MPI 79	(2012) Primer, Alkyd, Anti-Corrosive for Metal
NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)	
NAAMM MBG 531	(2017) Metal Bar Grating Manual
NAAMM MBG 532	(2009) Heavy Duty Metal Bar Grating Manual
SOCIETY FOR PROTECTIVE COATINGS (SSPC)	
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Expansion Joint Covers, Installation Drawings; G M

Floor Gratings, Installation Drawings; G M

Dumpster and Chiller Enclosure Gates Drawings; G M

Bollards/Pipe Guards; G M

Miscellaneous Steel Framing for Plumbing Fixture Supports in Walls, Louvers and Overhead Coiling Doors, Installation Drawings; G M

Expansion Joint Covers; G M

Floor Gratings; G M

Dumpster and Chiller Enclosure Gates; G M

Recycled Content; G M

SD-07 Certificates

Certified Mill Test Reports for Chemistry and Mechanical Properties

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

1.5 MISCELLANEOUS REQUIREMENTS

1.5.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

1.5.2 Installation Drawings

Submit templates, erection, and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation in relation to the building construction.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content.

2.2 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied. Submit the manufacturer's certified mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.

2.2.1 Structural Carbon Steel

Provide in accordance with ASTM A36/A36M.

2.2.2 Structural Carbon Steel Tubing

Provide in accordance with ASTM A500/A500M.

2.2.3 Steel Carbon Steel Pipe

Provide in accordance with ASTM A53/A53M, Type E or S, Grade B.

2.2.4 Fittings for Carbon Steel Pipe

Provide standard malleable iron fittings in accordance with ASTM A47/A47M.

2.2.5 Structural Stainless Steel

Stainless round, square and rectangular tubing shall conform to the requirements of ASTM A554, Type 316.

Stainless steel plate shall conform to the requirements of ASTM A240/A240M, hot rolled, annealed, and pickled, Type 316.

Stainless steel flats, angles, tees, beams and channel shall conform to the requirements of ASTM A276, hot rolled or extruded, aneealed and pickled, TYPE 316.

2.2.6 Anchor Bolts

Provide in accordance with ASTM F1554. Where exposed, provide anchor bolts of the same material, color, and finish as the metal to which they are applied.

2.2.6.1 Expansion Anchors, Sleeve Anchors, Adhesive Anchors

Provide diameter of anchors as indicated. Minimum embedment shall be in

accordance with the ICC ESR reports for the anchor. Design values listed are as tested in accordance with ASTM E488/E488M.

2.2.6.2 Lag Screws and Bolts

Provide in accordance with ASME B18.2.1, type and grade best suited for the purpose.

2.2.6.3 Toggle Bolts

Provide in accordance with ASME B18.2.1.

2.2.6.4 Bolts, Nuts, Studs and Rivets

Provide in accordance with ASME B18.2.2 or ASTM A307.

2.2.6.5 Powder Actuated Fasteners

Follow safety provisions in accordance with ASSP A10.3.

2.2.6.6 Screws

Provide in accordance with ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.2.6.7 Washers

Provide plain washers in accordance with ASME B18.22M, ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers in accordance with ASME B18.21.2M, ASME B18.21.1.

2.2.6.8 Welded Headed Shear Studs

Provide in accordance with ASTM A108 or ASTM A29/A29M-12.

2.2.7 Aluminum Alloy Products

Provide in accordance with ASTM B209M, ASTM B209 for sheet plate, ASTM B221M, ASTM B221M, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Provide aluminum extrusions at least 3 mm thick and aluminum plate or sheet at least 1.3 mm thick.

2.3 FABRICATION FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

2.3.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in

accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3.4 Shop Cleaning and Painting

2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

2.3.4.2 Pretreatment, Priming and Painting

Apply pre-treatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 0.03 mm. Tint additional prime coat with a small amount of tinting pigment.

2.3.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3.6 Aluminum Surfaces

2.3.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.3.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with a anodized finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations. Provide in accordance with AA DAF45. Provide a polished satin finish on items to be anodized.

2.4 EXPANSION JOINT COVERS

Provide expansion joint covers constructed of extruded aluminum with anodized satin aluminum finish for walls and ceilings and standard mill finish for floor covers and exterior covers. Furnish plates, backup

angles, expansion filler strips and anchors as indicated on drawings.

2.5 FLOOR GRATINGS

Design steel grating in accordance with NAAMM MBG 531 and NAAMM MBG 532 for bar type gratings, or in accordance with manufacturer's charts for plank grating.

a. Design floor gratings to support a stress live load as indicated on drawings for the spans indicated, with maximum deflection of L/240.

b. In accordance with NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and to match grating finish.

2.6 BOLLARDS/PIPE GUARDS

Provide 150 mm prime coated standard weight steel pipe in accordance with ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 17 MPa.

2.7 DUMPSTER AND CHILLER ENCLOSURE GATES

Modular wall system swing gates within an extruded aluminum frame with aluminum posts and mounting plates, extruded top and bottom rails, 100 percent pvc plank infills with aluminum stiffeners which is integrated between each plank for reinforcing the gate structure. Gate style, size and panel infill styles to be vertical as indicated on the drawings. Warranty includes 20-year fade and stain resistance. Colors to be selected from the manufacturer’s standard color charts.

2.8 MISCELLANEOUS STEEL FRAMING

Provide miscellaneous steel framing for plumbing fixture supports in walls, louvers and overhead coiling doors as required for installation.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Include materials and parts necessary to complete each assembly, whether indicated or not. Miss-alignment and miss-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved, provide a smooth finish on exposed surfaces. Provide countersuck rivets where exposed. Provide coped and mitered corner joints aligned flush and without gaps.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts, expansion shields, powder-driven fasteners, toggle bolts (when approved for concrete), through bolts for masonry, headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous metal. Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise.

3.4 BUILT-IN WORK

Where necessary and not otherwise indicated, form built-in metal work for anchorage with concrete or masonry. Provide built-in metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M for carbon steel and AWS D1.6/D1.6M for stainless steel. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with AWS D1.1/D1.1M, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect in accordance with ASTM D1187/D1187M, asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

3.7 PREPARATION

3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.7.2 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 15 degrees C above the dew point of the surrounding air, or when surface temperature is below 7 degrees C or over 35 degrees C, unless approved by the Contracting Officer. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

3.8 EXPANSION JOINT COVERS

Provide in accordance with manufacturer's written instructions. Verify

installation allows specified movement prior to completion of work

3.9 INSTALLATION OF BOLLARDS/PIPE GUARDS

Set bollards/pipe guards vertically in concrete piers. Fill hollow cores with concrete having a compressive strength of 21 MPa.

-- End of Section --

SECTION 06 10 00

ROUGH CARPENTRY
08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN FOREST FOUNDATION (AFF)

ATFS STANDARDS	(2015) American Tree Farm System Standards of Sustainability 2015-2020

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	(2015) American Softwood Lumber Standard

AMERICAN WOOD COUNCIL (AWC)

AWC WFCM	(2012) Wood Frame Construction Manual for One- and Two-Family Dwellings

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA M2	(2016) Standard for the Inspection of Preservative Treated Wood Products for Industrial Use
AWPA M6	(2013) Brands Used on Preservative Treated Materials
AWPA P18	(2014) Nonpressure Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870	(2010) Voluntary Product Standard, PS 1-09, Structural Plywood

CSA GROUP (CSA)

CSA Z809-08	(R2013) Sustainable Forest Management

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2015) Principles and Criteria for Forest Stewardship

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

PEFC ST 2002:2013	(2015) PEFC International Standard Chain of Custody of Forest Based Products Requirements

SUSTAINABLE FOREST INITIATIVE (SFI)

SFI 2015-2019	(2015) Standards, Rules for Label Use, Procedures and Guidance

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Preservative-treated Lumber and Plywood; G R

SD-07 Certificates

Certificates of Grade

Preservative Treatment

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Do not use materials that have visible moisture or biological growth. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency must be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view must not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark must identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with

APA L870. Surfaces that are to be exposed to view must not bear grademarks or other types of identifying marks.

1.4.3 Preservative-Treated Lumber and Plywood

The Contractor is responsible for the quality of treated wood products. Each treated piece must be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor must provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.4 Fire-Retardant Treated Lumber

Mark each piece in accordance with AWPA M6, except pieces that are to be natural or transparent finished. In addition, exterior fire-retardant lumber must be distinguished by a permanent penetrating blue stain. Labels of a nationally recognized independent testing agency will be accepted as evidence of conformance to the fire-retardant requirements of AWPA M6.

1.5 SIZES AND SURFACING

ALSC PS 20 for dressed sizes of yard and structural lumber. Lumber must be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes must be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products must be as follows at the time of delivery to the job site:

a. Framing lumber and board, 19 percent maximum

1.7 PRESERVATIVE TREATMENT

a. 4 kg.25per cubic meter intended for above ground use.

b. All wood must be air or kiln dried after treatment. Specific treatments must be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Minimize cutting and avoid breathing sawdust. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution.

(1) Wood framing, woodwork, and plywood up to and including the subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 600 mm or less from the earth underneath.

(5) Nailers, edge strips, crickets, curbs, and cants for roof decks as indicated on drawings.

1.7.1 New Construction

Use a boron-based preservative conforming to AWPA P18, sodium silicate wood mineralization process, or Ammoniacal Copper Quaternary Compound to treat wood. Use boron-based preservatives for above-ground applications only.

1.8 ENVIRONMENTAL REQUIREMENTS

During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.

1.9 CERTIFICATIONS

1.9.1 Certified Wood Grades

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

1.9.2 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08, SFI 2015-2019, or other third party program certified by PEFC ST 2002:2013. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

1.9.3 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.9.3.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Conform to AWC WFCM and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering, unless otherwise indicated or specified. Select lumber

sizes to minimize waste. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner.

3.2 WASTE MANAGEMENT OF WOOD PRODUCTS

In accordance with the Waste Management Plan and as specified. Separate members larger than 406 mm, and multiple offcuts of any size larger than 305 mm. Clearly separate damaged wood and other scrap lumber for acceptable alternative uses on site, including blocking, and shims.

3.3 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements. Typical conversion is as shown:

PRODUCTS	INCH-POUND Nominal	METRIC Conversion
Sawn lumber	2 by 4	38 by 89 mm
	1 by	19 mm by
Stud spacing	16 inches	400 mm
	If not 48 inches panel	406 mm
Plywood	48 by 96 inches	1200 mm by 2400 mm

-- End of Section --

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SECTION 07 11 13

BITUMINOUS DAMPPROOFING
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4479/D4479M	(2007; E 2012; R 2012) Asphalt Roof Coatings - Asbestos-Free
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E1745	(2017) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E1993/E1993M	(1998; R 2013; E 2013) Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Materials

1.3 DELIVERY AND STORAGE

Deliver materials in sealed containers bearing manufacturer's original

labels. Labels shall include date of manufacture, contents of each container, performance standards that apply to the contents and recommended shelf life. While in storage, do not allow water based bituminous damproofing to freeze.

1.4 SAFETY AND HEALTH REQUIREMENTS

If coal-tar pitch materials are used, the Contractor shall conform to all OSHA 29 CFR 1926 and General Industry Health Standards as well as state and local standards.

PART 2 PRODUCTS

2.1 ASPHALT PRIMER

ASTM D41/D41M.

2.2 FIBROUS ASPHALT

ASTM D4479/D4479M, Type I for horizontal surfaces, Type II for vertical surfaces.

2.3 SURFACE PROTECTION

2.3.1 Polyethylene Sheet

ASTM E1745 Class C polyethylene sheeting, minimum 0.38 mm thickness or ASTM E1993/E1993M bituminous membrane or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Remove or cut form ties and repair all surface defects as required in Section 03 30 00 CAST-IN-PLACE CONCRETE. Clean concrete and masonry surfaces to receive dampproofing of foreign matter and loose particles. Apply dampproofing to clean dry surfaces. Moisture test in accordance with ASTM D4263. If test indicates moisture, allow a minimum of 7 additional days after test completion for curing. If moisture still exists, redo test until substrate is dry.

3.2 APPLICATION

Use cold-application method. Prime surfaces to receive fibrous asphaltic dampproofing unless recommended otherwise by dampproofing materials manufacturer. Apply dampproofing after priming coat is dry, but prior to any deterioration of primed surface, and when ambient temperature is above 4 degrees C.

3.2.1 Surface Priming

Prime surfaces to receive fibrous asphalt dampproofing with asphalt primer. Apply primer when ambient temperature is above 4 degrees C and at rate of approximately 4 liters per 10 square meters, fully covering entire surface to be dampproofed.

3.2.2 Cold-Application Method

3.2.2.1 Fibrous Asphalt

Apply two coats of fibrous asphalt to surfaces to be dampproofed. Apply each coat uniformly using not less than 4 liters fibrous asphalt per 5 square meters. Apply first coat by brush or spray to provide full bond with primed surface. Brush or spray second coat over thoroughly dry first coat unless recommended otherwise by dampproofing materials manufacturer. Provide finished surface that is of uniform thickness and impervious to moisture. Recoat porous areas.

3.3 PROTECTIVE COVERING

Protect dampproofed surfaces with 2 layers of polyethylene sheet.

-- End of Section --

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SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING
02/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	(2016) Specifications for Structural Concrete

ASTM INTERNATIONAL (ASTM)

ASTM C1305	(2008) Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D146/D146M	(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D903	(1998; R 2017) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D1876	(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM D5385/D5385M	(1993; R 2014; E 2014) Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E154/E154M	(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Standard Details

Elastomeric Waterproofing Sheet Material

Protection Board

Primers, Adhesives, and Mastics

SD-06 Test Reports

Elastomeric Waterproofing Sheet Material; G M

Field Quality Control documentation; G M

Protective Covering; G M

SD-07 Certificates

Elastomeric Waterproofing Sheet Material

Primers, Adhesives, and Mastics

Special Warranties

Certificates Of Compliance

SD-08 Manufacturer's Instructions

Primers, Adhesives, and Mastics

SD-11 Closeout Submittals

Certificates Of Compliance with sustainable requirements for items listed in SD-07; G M/R

1.3 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protective coverings, and manufacturer's Safety Data Sheets (SDS) for primers, adhesives, and mastics.

1.5 DELIVERY, STORAGE, HANDLING, IDENTIFICATION

Deliver and store materials in accordance with manufacturer's printed instructions, out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Do not permit unidentified materials in the work area or in the project.

1.6 SPECIAL WARRANTIES

1.6.1 Guarantee

Guarantee waterproofing membrane installation against failure due to leaks for a period of two years from the date of Beneficial Occupancy. Submit draft and final guarantees in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS .

1.6.2 Warranty

Provide manufacturer's material warranty for all system components for a period of ten years from the date of Beneficial Occupancy. Submit draft and final warranties in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS .

PART 2 PRODUCTS

2.1 SUSTAINABILITY CRITERIA

Where allowed by performance criteria:

2.1.1 Reduced Volatile Organic Compound (VOC) Content

Provide products with reduced VOC content and provide certificates of compliance.

2.1.2 Recycled Content

Provide products with recycled content and provide certificates of compliance.

2.2 MATERIALS

Provide one of the types of elastomeric waterproofing sheet material and related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials with each other, and with

materials on which they are applied. Provide materials that comply with applicable requirements cited below when tested in accordance with the referenced ASTM publications.

2.3 COMPOSITE, SELF-ADHERING MEMBRANE SHEETING

Cold applied composite sheet consisting of rubberized asphalt and cross laminated, high density polyethylene film. Not less than 1.5 mm minimum thickness is required.

2.3.1 Composite, Self-Adhering Sheeting Performance Requirements

a. Tensile Strength ASTM D412, Die C: 1.6 MPa minimum.

b. Ultimate Elongation, ASTM D412, Die C: 200 percent minimum.

c. Water Vapor Transmission, ASTM E96/E96M 26.7 degrees C Permeance, Procedure B: 5.72 by 10-7 g/Pa.s.m2 maximum.

d. Pliability degrees, ASTM D146/D146M: (180 degrees Bend Over 25 mm Mandrel): No cracks at minus 32 degrees C minus.

e. Provide test report data for crack bridging ability: Either in accordance with ASTM C1305 as modified for a dry film thickness specified by the manufacturer and conducted at low temperature; or in accordance with a cycling over crack test also conducted for the specified dry film thickness at low temperature. Using either test, verify crack bridging up to 6 mm without damage to the membrane system.

f. Puncture Resistance, ASTM E154/E154M REV A: 18 kg minimum.

g. Lap Adhesion at Minimum Application Temperature, ASTM D1876 Modified, 880 N/m.

h. Peel Strength, ASTM D903: Modified 1576 N/m

i. Resistance to Hydrostatic Head, ASTM D5385/D5385M: 70 m of water.

j. Water Absorption, ASTM D570; 0.1 percent maximum.

2.3.2 Primers

Asphalt composition, ASTM D41/D41M, or synthetic polymer in solvent as recommended by the membrane manufacturer.

2.3.3 Mastics

Polymer modified asphalt in suitable solvent of trowel grade consistency and as recommended by the membrane manufacturer.

2.4 Protection Board

Provide protection board that is compatible with the waterproofing membrane. Use a minimum 13 mm thick fir bitumen impregnated board 25 mm for polystyrene 3 mm thick for vertical and 6 mm for horizontal premolded bituminous protection board as recommended by the manufacturer.

PART 3 EXECUTION

3.1 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing during inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive waterproofing for when ambient and surface temperatures are 4 degrees C or below. Avoid installation during high humidity (over 60 percent). Reference ASTM field test (ASTM D4263 - Concrete Moisture Test) for determining acceptable concrete substrate moisture.

3.2 VERIFICATION OF CONDITIONS

Before starting the work, verify surfaces that must be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions anticipated to prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.3 SURFACE PREPARATION

Ensure surfaces to receive treatment are clean, dry, smooth, and free from deleterious materials and projections. Cut off high spots or grind smooth. Finish top surfaces of projecting masonry or concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to receive covering before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system. Referencing ACI 117 / ACI 301 for the desired surface finish criteria and surface defect tolerances.

3.4 APPLICATION

3.4.1 Building Envelope Requirements

Provide a continuous waterproofing system at all material and building transitions. Lap, wrap, fasten and seal products in accordance with manufacturer's printed instructions. Envelope assembly variations are not permitted without written approval from the Contracting Officer's Representative.

3.4.2 General Installation Requirements

Provide sheet waterproofing in accordance with manufacturer's printed installation instructions. Ensure the surface to receive membrane is clean, smooth and dry without surface irregularities; correct deficiencies prior to installation. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor and provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

3.4.2.1 Self-Adhering Membrane

Apply composite, self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with membrane manufacturer's printed instructions. Remove release sheet and apply with tacky surface in contact with dried primer.

3.4.2.2 Protection

Protect membrane over horizontal surfaces from traffic during installation. Use only equipment with rubber tires. Provide walkway protection where heavy traffic from other trades is expected. Do not store material on membrane.

3.5 COMPOSITE, SELF-ADHERING MEMBRANE

Lap sheets at edges and ends a minimum of 65 mm over the preceding sheet. Provide all side laps a minimum 65 mm and end laps 127 mm. Provide self-adhesive, mastic laps in accordance with manufacturer's recommendation. Roll or firmly press to adhere membrane to substrate. Cover corners and joints with two layers of reinforcement by first applying a 300 mm width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 150 mm from the drain or projection. Finish exposed, terminated edges of membrane on horizontal or vertical surfaces with a toweled bead of mastic. Apply mastic around edges of membrane, and drains and projections. Apply mastic at end of each work day.

3.6 FLASHING

Flash penetrations through membrane. Seal all penetrations where reinforcing bars penetrate a waterproofing membrane with the appropriate sealant or mastic flashing component. Embed elastomeric membrane in a heavy coat of adhesive, except for self-adhering membrane. Position continuous metal reglets horizontally on footing and vertically on intersecting and connecting walls, and as specified in Section 07 60 00 FLASHING AND SHEET METAL. Metal reglets are to receive exposed edges of membrane waterproofing. Secure membrane into reglets by lead wedges and fill with cement as recommended in writing by manufacturer of waterproofing materials. Counterflash upper edge of membrane waterproofing and protective covering as specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.7 FIELD QUALITY CONTROL

Notify the Contracting Officer 5 working days prior to date of performing tests. Before concealment, cover elastomeric waterproofing on horizontal surfaces over finished spaces with 100 mm of ponded water for 24 hours. Do not add water after start of 24 hour period. Accurately measure water level at beginning and end of 24 hour period. If water level falls, remove water and inspect waterproofing membrane. Make repairs or replacement as directed, and repeat test. Do not proceed with work that conceals membrane waterproofing before receiving approval and acceptance of the Contracting Officer. Perform "pull-off test" on the membrane. Reference ASTM D4541 for pull-off strength of coatings using portable adhesion testers.

3.8 PROTECTIVE COVERING

After installation has been inspected and approved by the Contracting Officer, apply a protective covering to the membrane waterproofing prior to backfilling. Protect vertical membrane waterproofing with a 13 mm minimum thickness of asphalt plank; 13 mm minimum thickness of fiberboard; or 3 mm minimum thickness of compatible water resistant bitumen type protection board with edges abutting adjacent edges and exposed surfaces

covered by a taping system recommended by manufacturer of protection board. Cover horizontal membrane waterproofing with similar protection board and Portland cement mortar not less than 20 mm thick; place uniformly and allow to set before installing subsequent construction.

-- End of Section --

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SECTION 07 21 13

BOARD AND BLOCK INSULATION
02/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C272/C272M	(2016) Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
ASTM C553	(2013) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C591	(2017) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C930	(2019) Standard Classification of Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D1621	(2016) Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D3833/D3833M	(1996; R 2011) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2015) International Building Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 31	(2016) Standard for the Installation of Oil-Burning Equipment

NFPA 54	(2018) National Fuel Gas Code
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Standard Details

Block or Board Insulation

Vapor Retarder

Pressure Sensitive Tape

Accessories including sealants

Recycled Content for Block or Board Insulation

SD-07 Certificates

Block or Board Insulation

Vapor Retarder

Indoor Air Quality For Block Or Board Insulation

SD-08 Manufacturer's Instructions

Block or Board Insulation

Adhesive

1.3 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protection board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.5.2 Storage

Inspect materials delivered to the site for damage and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Comply with manufacturer's recommendations for handling, storage, and protection of materials before and during installation.

1.6 SAFETY PRECAUTIONS

Comply with the safety requirements of ASTM C930.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide thermal insulating materials as recommended by manufacturer for each type of application indicated. Provide insulation with the following physical properties and in accordance with the following standards:

a. Unfaced Preformed Rigid Polyurethane and Polyisocyanurate Board: ASTM C591

2.1.1 Thermal Resistance

Unless otherwise indicated, Wall R-20.

2.1.2 Fire Protection Requirements

a. Flame spread index of 75 or less when tested in accordance with ASTM E84.

b. Smoke developed index of 450 or less when tested in accordance with ASTM E84.

c. Provide insulated assemblies in accordance ICC IBC Chapter Fire and Smoke Protection Features.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 170 kilopascals (kPa) when measured according to ASTM D1621.

b. Water Vapor Permeance: Not more than 6.3 by 10-8 g/Pa.s.m2 or less when measured according to ASTM E96/E96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.

c. Water Absorption: Not more than 2 percent by total immersion, by volume, when measured according to ASTM C272/C272M.

d. Water Adsorption: Not more than 1 percent by volume when measured in accordance with paragraph 14 of ASTM C553.

2.1.4 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum required recycled material contents (by weight, not volume) are:

Polyisocyanurate/Polyurethane:	9 percent
Phenolic Rigid Foam:	5 percent
Perlite Board:	75 percent post consumer paper

Provide data identifying percentage of recycled content for block or board insulation.

2.1.5 Indoor Air Quality

Provide certification of indoor air quality for block or board insulation.

2.1.6 Prohibited Materials

Do not provide materials containing asbestos.

2.2 VAPOR RETARDER AND DAMPPROOFING

2.2.1 Dampproofing for Masonry Cavity Walls

Bituminous material is specified in Section 07 11 13 BITUMINOUS DAMPPROOFING.

2.3 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder(s). Match water vapor permeance rating for each vapor retarder specified. Provide tape in accordance with ASTM D3833/D3833M.

2.4 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.5 ACCESSORIES

2.5.1 Adhesive

As recommended by insulation manufacturer.

2.5.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Prior to installation, ensure all areas that are in contact with the insulation are dry and free of projections that could cause voids, compressed insulation, or punctured vapor retarders. For foundation perimeter or under slab applications, check that subsurface fill is flat, smooth, dry, and well tamped. Do not proceed with installation if moisture or other conditions are present, and notify the Contracting Officer of such conditions. Do not proceed with the work until conditions have been corrected and verified to be dry.

3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Provide noncombustible blocking at all spaces between heat producing devices and the floors, ceilings and roofs through which they pass. Provide in accordance with the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 75 mm from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is placed above fixture or device, 600 mm above fixture.

b. Masonry chimneys or masonry enclosing a flue: 50 mm from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

d. Gas Fired Appliances: Clearances as required in NFPA 54.

e. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking is not required if chimneys or flues are certified in writing by the chimney or flue manufacturer for use in contact with specific insulating materials.

3.3 INSTALLATION

3.3.1 Installation and Handling

Provide insulation in accordance with the manufacturer's printed

installation instructions. Keep material dry and free of extraneous materials.

3.3.2 Electrical Wiring

Do not install insulation in a manner that would enclose electrical wiring between two layers of insulation.

3.3.3 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating thermal bridges and voids. Provide and verify continuity of insulative barrier throughout the building enclosure.

3.3.4 Coordination

Verify final installed insulation thicknesses comply with thicknesses indicated, R-values specified herein, and with the approved insulation submittal(s).

3.4 INSTALLATION ON WALLS

3.4.1 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

a. Full back bed method or

b. As recommended by the insulation manufacturer.

c. Use only full back method for pieces of 0.1 square meter or less.

d. Butt all edges of insulation and seal edges with tape.

3.4.2 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners and bend split prongs to provide a flush condition with the insulation. Butt all edges of insulation and seal with tape.

3.5 PERIMETER INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls and slab edges in slab-on-grade construction.

3.5.1 Insulation on Vertical Surfaces

Provide thermal insulation on exterior of foundation walls on grade beams below grade and on edges of slabs-on-grade. Fasten insulation with adhesive or mechanical fasteners.

3.5.2 Protection of Insulation

Protect insulation from damage during construction and back filling by application of protection board or a coating. Do not leave installed

vertical insulation unprotected overnight. Protect installed insulation from weather, including rain and ultraviolet light, from mechanical abuse, compression, and dislocation. Install protection over entire exposed exterior insulation board. Extend protection at least 300 mm below grade.

3.6 VAPOR RETARDER

Apply vapor retarder continuous across all surfaces. Overlap all joints at least 150 mm and seal with pressure sensitive tape. Seal at sills, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

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SECTION 07 22 00

ROOF AND DECK INSULATION
02/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1177/C1177M	(2017) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1289	(2018a) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4450	(1989) Approval Standard for Class 1 Insulated Steel Deck Roofs
FM 4470	(2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2015) International Building Code

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

UNDERWRITERS LABORATORIES (UL)

UL 1256	(2002; Reprint Jul 2013) Fire Test of Roof Deck Constructions
UL 2818	(2013) GREENGUARD Certification Program

For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Insulation Board Layout and Attachment; G R

SD-03 Product Data

Insulation

Cover Board

Fasteners

Recycled Content For Insulation

SD-06 Test Reports

Flame Spread Rating; G R

SD-07 Certificates

Installer Qualifications

Certificates Of Compliance For Felt Materials

Indoor Air Quality For Insulation

SD-08 Manufacturer's Instructions

Nails and Fasteners

Roof Insulation

1.3 SHOP DRAWINGS

Submit insulation board layout and attachment indicating methods of attachment and spacing, transitions, tapered components, thicknesses of materials, and closure and termination conditions. Show locations of ridges, valleys, crickets, interface with, and slope to, roof drains. Base shop drawings on verified field measurements and include verification of existing conditions. Show wood nailers.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for cover board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 MANUFACTURER'S INSTRUCTIONS

Include field of roof and perimeter attachment requirements.

Provide a complete description of installation sequencing for each phase of the roofing system. Include weatherproofing procedures.

1.6 QUALITY CONTROL

Provide certification of installer qualifications from the insulation manufacturer confirming the specific installer has the required qualifications for installing the specific roof insulation system(s) indicated.

Provide certificates of compliance for felt materials.

1.7 FM APPROVAL REQUIREMENTS

Provide fastening patterns in accordance with FM 1-90 for insulation on steel decks.

1.8 FIRE PERFORMANCE REQUIREMENTS

1.8.1 Insulation in Roof Systems

Comply with the requirements of ICC IBC or UL 1256. Roof insulation to have a flame spread rating of 75 or less when tested in accordance with ASTM E84. Additional documentation of compliance with flame spread rating is not required when insulation of the type used for this project as part of the specific roof assembly is listed and labeled as FM Class 1 approved.

1.8.2 Fire Resistance Ratings for Roofs

Provide in accordance with ICC IBC Chapter 7 and Table 721.1(3) Min Fire and Smoke Protection For Floor and Roof Systems.

1.9 CERTIFICATIONS

Provide products certified to meet indoor air quality requirements by UL 2818(Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification documentation from certification body.

1.10 DELIVERY, STORAGE, AND HANDLING

1.10.1 Delivery

Deliver materials to the project site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer

b. Brand designation

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification

Deliver materials in sufficient quantity to allow continuity of the work.

1.10.2 Storage and Handling

Store and handle materials in accordance with manufacturer's printed instructions. Protect from damage, exposure to open flame or other ignition sources, wetting, condensation, and moisture absorption. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material.

1.11 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 4 degrees C and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

1.12 PROTECTION

Provide protection as approved by the insulation manufacturer.

1.12.1 Completed Work

Cover completed work with cover board for the duration of construction. Avoid traffic on completed work particularly when ambient temperature is above 27 degrees C. Replace crushed or damaged insulation prior to roof surface installation.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

a. Polyisocyanurate Board: Provide in accordance with ASTM C1289 REV A Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength of 140 kilopascal (kPa).

2.1.2 Recycled Materials

Provide thermal insulation materials containing recycled content. Unless specified otherwise, the minimum required recycled content for listed materials are:

Perlite Composition Board:	75 percent postconsumer paper
Polyisocyanurate/polyurethane:	9 percent recovered material
Wood Fiberboard:	100 percent recovered material
Cellular Glass Insulation:	75 percent recovered content
Structural Fiberboard:	100 percent recovered content

Fiberglass Insulation:	25 percent recovered content
Fiber (felt) or Fiber composite:	75 percent recovered content
Rubber:	90 percent recovered content
Plastic or Plastic/Rubber composite:	90 percent recovered content
Wood/Plastic Composite:	90 percent total recovered content

Provide data identifying percentage of recycled content for insulation.

2.1.3 Indoor Air Quality

Provide certification of indoor air quality for insulation.

2.1.4 Insulation Thickness

As necessary to provide the thermal resistance (R-value) indicated for average thickness of tapered system. Base calculation on the R-value for aged insulation.

2.1.5 Tapered Roof Insulation

One layer of the tapered roof insulation assembly must be factory tapered to a slope of not less than 2 percent. Factory fabricate mitered joints from two diagonally cut boards or one board shaped to provide required slopes.

2.1.6 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation. When unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer for the specific application, unless otherwise indicated. Face of cant strips to incline at 45 degrees with a minimum vertical height of 100 mm. Taper edge strips at a rate of 85 to 125 mm per meter down to approximately 3 mm thick.

2.2 COVER BOARD

For use as a thermal barrier (underlayment), fire barrier (overlayment), or cover board for hot-mopped, torched-down, or adhesive-applied roofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C1177/C1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E84, 3450 kPa, Class A, non-combustible, 16 mm thick, 1220 by 2440 mm board size.

2.3 FASTENERS

Provide flush-driven fasteners through flat round or hexagonal steel or plastic plates. Provide zinc-coated steel plates, flat round not less than 35 mm diameter, hexagonal not less than 0.4 mm. Provide high-density plastic plates, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 75 mm in diameter. Fully recess fastener head into

plastic plate after it is driven. Form plates to prevent dishing. Do not use bell or cup shaped plates. Provide fasteners in accordance with insulation manufacturer's recommendations for holding power when driven, or a minimum of 178 N each in steel deck, whichever is the higher minimum. Provide fasteners for steel or concrete decks in accordance with FM APP GUIDE (http://www.approvalguide.com/) for Class I roof deck construction, and spaced to withstand uplift pressure of 4.3 kPa.

2.3.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws in accordance with FM 4450 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of 4.31 kPa in accordance with FM APP GUIDE.

2.3.2 Fasteners for Poured Concrete Decks

Approved hardened fasteners or screws to penetrate deck at least 25 mm but not more than 38 mm, in accordance with FM 4470, and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of 4.31 kPa in accordance with FM APP GUIDE.

2.4 WOOD NAILERS

Pressure-preservative treated as specified in Section 06 10 00 ROUGH CARPENTRY.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Ensure surfaces are clean, smooth, and dry prior to application. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor must inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

a. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

b. Prior to installing any roof system on a concrete deck, moisture test the deck in accordance with ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage from hollow or low spots, perform the following:

a. Provide wood nailers of the same thickness as the insulation at eaves, edges, curbs, walls, and roof openings for securing of cant strips, gravel stops, and flashing flanges.

b. Cover steel decks with a layer of insulation board of sufficient width to span the width of a deck rib opening, and in accordance with fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement in accordance with FM APP GUIDE. Locate insulation joints parallel to ribs of deck on solid bearing surfaces only, not over open ribs.

3.2 INSULATION INSTALLATION

Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 13 mm. Lay insulation so that continuous longitudinal joints are perpendicular to direction of felts for the built-up roofing, as specified in Section 07 54 19 POLYVINYL-CHLORIDE ROOFING, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, provide joints of each succeeding layer that are parallel and offset in both directions with respect to the layer below. Keep insulation 13 mm clear of vertical surfaces penetrating and projecting from roof surface. Verify required slopes to each roof drain.

3.2.1 Installation Using Asphalt

Firmly embed each layer in solid asphalt mopping; mop only sufficient area to provide complete embedment of one board at a time. Provide 10 to 18 kgs of asphalt per 10 square meters of roof deck for each layer of insulation. Apply asphalt when temperature is within plus or minus 15 degrees C of EVT. Do not heat asphalt above asphalt's FBT or 275 degrees C, whichever is less, for longer than 4 consecutive hours. Use thermometers to check temperatures during heating and application.

3.2.2 Installation of Protection for Asphalt Work

Before starting asphalt work, protect surrounding areas and surfaces from spillage and migration of asphalt onto other work. Provide non-combustible protective coverings at surfaces adjacent to hoists and kettles. Lap protective coverings at least 150 mm, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of asphalt work.

3.2.3 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

3.2.4 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 13 mm thick wood fiberboard, glass mat gypsum roof board, or 19 mm thick expanded perlite board insulation over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.2.5 Cant Strips

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips must bear on and be anchored to wood blocking. Fit cant strips flush to vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in an approved adhesive.

3.2.6 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by the juncture of roof and wood nailing strips that extend above the level of the roof. Install edge strips flush to vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in an approved adhesive.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with finished roofing on same day. Phased construction is not permitted. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces is not permitted. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight in accordance with live load limits of roof construction. Protect exposed edges of insulation with cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs must be two layers of bituminous-saturated felt set in plastic bituminous cement set in roof cement. Fill all profile voids in cutoffs to prevent trapping moisture below the membrane. Remove cutoffs when work resumes.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 INSPECTION

Establish and maintain inspection procedures to assure compliance of the installed roof insulation with contract requirements. Remove, replace, correct in an approved manner, any work found not in compliance. Quality control must include, but is not limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM Data Sheets. (https://www.fmglobal.com/fmglobalregistration/Downloads.aspx)

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.

e. Inspection of mechanical fasteners; type, number, length, and spacing.

f. Coordination with other materials, cants, sleepers, and nailing strips.

g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

h. Installation of cutoffs and proper joining of work on subsequent days.

i. Continuation of complete roofing system installation to cover insulation installed same day.

j. Verification of required slope to each roof drain.

-- End of Section --

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SECTION 07 27 10.00 10

BUILDING AIR BARRIER SYSTEM
05/14

PART 1 GENERAL

1.1 SUMMARY

This Section specifies the construction and quality control of the installation of an air barrier system. Construct the air barrier system indicated, taking responsibility for the means, methods, and workmanship of the installation of the air barrier system. The air barrier must be contiguous and connected across all surfaces of the enclosed air barrier envelope indicated. The maximum leakage requirements of individual air barrier components and materials are specified in the other specification sections covering these items.

This section also defines the maximum allowable leakage of the final air barrier system. The workmanship must be adequate to meet the maximum allowable leakage requirements of this specification. Test the assembled air barrier system to demonstrate that the building envelope is properly sealed and insulated. Passing the air barrier system leakage test and thermography test will result in system acceptance.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Accessory

Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).

1.3.2 Air Barrier Assembly

The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.

1.3.3 Air Barrier Component

Pre-manufactured elements such as windows, doors, dampers and service elements that are installed in the environmental separator.

1.3.4 Air Barrier Envelope

The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.

1.3.5 Air Barrier Material

A building material that is designed and constructed to provide the primary resistance to airflow through an air barrier assembly.

1.3.6 Air Barrier System

Same as AIR BARRIER ENVELOPE.

1.3.7 Air Leakage Rate

The rate of airflow (L/s) driven through a unit surface area (sq. m) of an assembly or system by a unit static pressure difference (Pa) across the assembly. (example: 1.27 L/s-m^2 @ 75 Pa)

1.3.8 Air Leakage

The total airflow (L/s) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope. (example: 3070 L/s @ 75 Pa)

1.3.9 Air Permeance

The rate of airflow (L/s) through a unit area (sq. m) of a material driven by unit static pressure difference (Pa) across the material (example: 0.02 L/s-m^2 @ 75 Pa).

1.3.10 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. Also known as the Control Layer.

1.4 PREPARATORY PHASE OR PRECONSTRUCTION CONFERENCE

Organize pre-construction conferences between the air barrier inspector and the sub-contractors involved in the construction of or penetration of the air barrier system to discuss where the work of each sub-contractor begins and ends, the sequence of installation, and each sub-contractor's responsibility to ensure airtight joints, junctures, penetrations and transitions between materials. Discuss the products, and assemblies of products specified in the different sections to be installed by the different sub-contractors.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Design Review Report; G M

Two copies not later than 14 days after approval of the Air Barrier Inspector Qualifications.

Testing and Inspection; G M

SD-07 Certificates

Air Barrier Inspector

Two copies 30 days after Notice to Proceed.

SD-09 Manufacturer's Field Reports

Installation reports and documentation of the testing as a submittal, not later than 7 days after testing.

1.6 AIR BARRIER INSPECTOR

Employ a designated Air Barrier Inspector on this project. The Air Barrier Inspector performs a Design Review, oversees quality control testing specified in these specifications, performs quality control air barrier inspection as specified, interfaces with the designer and product manufacturer's representatives to assure all installation requirements are met, and coordinates efforts between all workers installing or penetrating the air barrier materials. Qualification for the Air Barrier Inspector are as follows:

a. Training and certification as an Air Barrier Installer from the Air Barrier Association of America (ABAA) or other third party air barrier association.

b. Experience coordinating and instructing personnel involved in the installation, joining, and sealing of air barrier materials and components.

1.7 DESIGN REVIEW

Review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the construction of an effective air barrier system. Provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper air barrier system.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 QUALITY CONTROL

3.1.1 Documentation and Reporting

Document the entire installation process and submit a report weekly during this activity's duration. This weekly report includes the status of this activity, the status of work completed or delayed, and include information on the Installer, the presence or absence of the air barrier inspector during the installation, substrates, substrate preparation, products used, ambient and substrate temperature, the location of the air barrier installation, the results of the quality control procedures, and testing results. At the completion of the installation, submit a complete, comprehensive report covering the above items.

3.1.2 Quality Control Testing And Inspection

Conduct the following tests and inspections as applicable in the presence of the Contracting Officer during installation of the air barrier system, and submit quality control reports as indicated below.

a. Provide a Daily Report of Observations with a copy to the Contracting Officer.

b. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.

c. Inspect to assure structural support of the air barrier system to withstand design air pressures.

d. Inspect and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.

e. Inspect to assure substrate surfaces are properly primed if applicable and in accordance with manufacturer's instructions. Priming must extend at least 50.8 mm beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.

f. Inspect to assure laps in materials are at least a 50.8 mm minimum, shingled in the correct direction or mastic applied in accordance with manufacturer's recommendations, and with no fishmouths.

g. Measure application thickness of liquid applied materials to assure that manufacturer's specifications for the specific substrate are met.

h. Inspect to assure that the correct materials are installed for compatibility.

i. Inspect to assure proper transitions for change in direction and structural support at gaps.

j. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.

k. Perform adhesion tests for fluid-applied and self-adhered air barrier membranes to assure that the manufacturer's specified adhesion strength properties are met. Determine the bond strength of coatings to substrate in accordance with ASTM D4541.

3.2 REPAIR AND PROTECTION

Upon completion of inspection, testing, sample removal and similar services, repair damaged construction and restore substrates, coatings and finishes. Protect construction exposed by or for quality control service activities, and protect repaired construction.

-- End of Section --

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SECTION 07 27 19.01

SELF-ADHERING AIR BARRIERS
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation	Accreditation
ABAA QAP	Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM D146/D146M	(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D1876	(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D903	(1998; R 2017) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM E154/E154M	(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E2178	(2013) Standard Test Method for Air Permeance of Building Materials
ASTM E2357	(2017) Standard Test Method for Determining Air Leakage of Air Barrier

	Assemblies
ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components, and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G M/R

Qualifications of Installer; G M/R

SD-02 Shop Drawings

Self-adhering Air Barrier; G M

SD-03 Product Data

Self-adhering Air Barrier

Primers, Adhesives, and Mastics

Safety Data Sheets

SD-06 Test Reports

Field Peel Adhesion Test; G M

Flame Propagation of Wall Assemblies; G M

Flame Spread and Smoke Developed Index Ratings; G M

Site Inspections and Testing; G M

SD-07 Certificates

Self-adhering Air Barrier

Qualifications of Manufacturer

Qualifications of Installer

SD-08 Manufacturer's Instructions

Self-adhering Air Barrier

Primers, Adhesives, and Mastics

1.4 MISCELLANEOUS REQUIREMENTS

For self-adhering air barrier provide the following:

1.4.1 Shop Drawings

Submit self-adhering air barrier shop drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other building enclosure assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.4.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

1.4.3 Mockup

Provide a mockup of the self-adhering air barrier system specified. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 5 square meters. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

1.4.4 Test Reports

Submit test reports indicating that field peel-adhesion tests on all materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier system materials tested in accordance with ASTM E84.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight. Keep materials sealed and separated from absorptive materials, such as wood and insulation.

1.6 QUALITY ASSURANCE

1.6.1 Qualifications of Manufacturer

Submit documentation verifying that the manufacturer of the self-adhering air barrier is currently accredited by Air Barrier Association of America (ABAA Accreditation https://www.airbarrier.org/).

1.6.2 Qualifications of Installer

Submit documentation verifying that installers of the self-adhering air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (https://www.airbarrier.org/qap/).

1.7 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a minimum, construction and testing of mockup, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the air barrier system.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Temperature

Install air barrier within the range of ambient and substrate temperatures as recommended in writing by the air barrier manufacturer. Verify that the surface to receive self-adhering air barrier is dry for a minimum of 48 hours prior to the installation of the barrier. Do not apply air barrier to damp or wet substrates. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

1.8.2 Exposure to Weather and Ultraviolet Light

Protect air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

PART 2 PRODUCTS

2.1 SELF ADHERING AIR BARRIER

Provide minimum 40 mils thick self-adhering, vapor permeable, air barrier membrane consisting of a cross-laminated high density polyethylene (HDPE) film, fully coated with rubberized asphalt adhesive. Provide membrane in rolls of various widths interleaved with disposable silicone release paper. Self-adhering air barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Use regular or low temperature formulation depending on site conditions, within temperature ranges specified by manufacturer.

2.1.1 Physical Properties

a. Air Permeance (ASTM E2178): Less than 0.02 L per s-m2 at 75 Pa.

b. Air Leakage (ASTM E2357, ASTM E283): In accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM less than 0.02 L per s-m2 at 75 Pa at 25 mm.

c. Tensile Strength (ASTM D412 die C modified): Not less than 2.8 MPa.

d. Tensile Elongation (ASTM D412 die C modified): Not less than 200 percent.

e. Puncture Resistance (ASTM E154/E154M): Not less than 178 N.

f. Pliability (ASTM D146/D146M): Unaffected at minus 32 degrees C, 1.6 mm mandrel.

g. Lap Adhesion (ASTM D1876 modified): Not less than 700 N per meter.

h. Peel Adhesion (ASTM D903): Not less than 875 N per meter.

i. Water Absorption (ASTM D570): Not to exceed 0.12 percent by weight.

j. Flame propagation of wall assemblies (NFPA 285): Pass

k. Surface Burning Characteristics (ASTM E84):

(1) Flame Spread Index Rating not higher than 75.

(2) Smoke Developed Index Rating not higher than 150.

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics and other accessory materials as recommended in writing by the manufacturer of the self-adhering air barrier for adequate bonding to each type of substrate.

2.3 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.4 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS. Verify compatibility with adjacent products that are or will be in contact with one another.

PART 3 EXECUTION

3.1 EXAMINATION

Before installing air barrier, examine substrates, areas, and conditions under which air barrier assemblies will be applied, with Installer present, for compliance with requirements. Ensure the following conditions are met:

a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.

b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.

c. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.

d. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel adhesion test on materials to which sealants are adhered.

3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for air barrier application.

a. Prime masonry and concrete substrates with conditioning primer.

b. Prime gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.

c. Prime wood, metal, and painted substrates with primer.

d. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and at protrusions.

3.3 INSTALLATION

3.3.1 Installation of Self-adhering Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

a. Apply primer at rate recommended by manufacturer prior to membrane installation. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.

b. When membrane is properly positioned, press into place and roll membrane with roller immediately after placement.

c. Apply membrane sheets to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.

d. Position subsequent sheets of membrane applied above so that membrane overlaps the membrane sheet below by a minimum of 65 mm, unless greater overlap is recommended by manufacturer. Roll into place with roller.

e. Make all side laps a minimum of 65 mm and all end laps a minimum of 127 mm, unless greater overlap is recommended by manufacturer. Roll seams with roller.

f. Roll membrane to adhere to substrate. Cover corners and joints with two layers of reinforcement by first applying a 300 mm width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 150 mm from the drain or projection.

g. Seal around all penetrations through the air barrier resulting from pipes, vents, conduit, electrical fixtures, structural members, or other construction passing through it. Seal with termination mastic, extruded silicone sealant, membrane counterflashing or other sealing methods in accordance with manufacturer's written recommendations.

h. Continuously connect the air barrier between walls, roof, floor and below grade assemblies to form a continuous integrated air barrier system around the entire building enclosure. Extend the air barrier membrane into rough openings such as doors, windows, louvers, and other exterior penetrations. Seal edges of barrier at junctures with rough openings.

i. At changes in substrate plane, provide transition material (e.g. bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.

j. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to

the other. Continuously support membrane with substrate.

k. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.

l. At expansion and seismic joints provide transition to the joint assemblies.

m. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.

n. At end of each working day, seal top edge of membrane to substrate with termination mastic.

o. Do not allow materials to come in contact with chemically incompatible materials.

p. Counterflash upper edge of thru-wall flashing and air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (https://www.airbarrier.org/qap/), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and this section.

a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written site inspections and testing reports to the Contracting Officer within five working days of the inspection and test being performed.

b. If inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

3.5 FIELD PEEL ADHESION TEST

Perform a field peel-adhesion test on the construction mockup. Test the self-adhering air barrier for adhesion in accordance with ASTM D4541 using a Type II pull tester except use a disk that is 100 mm in diameter and cut through the membrane to separate the material attached to the dish from the surrounding material. Perform test after curing period in accordance with manufacturer's written recommendations. Record mode of failure and area which failed in accordance with ASTM D4541. Compare adhesion values with the manufacturer's established minimum values for the particular combination of material and substrate. Indicate on the inspection report whether the manufacturer's requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product and substrate combination, the inspector must record actual values.

3.6 PROTECTION AND CLEANING

3.6.1 Protection

3.6.1.1 Adjacent Surfaces

Protect exposed adjacent surfaces that could be damaged by primers and adhesives associated with air barrier membrane. Provide protection during application and the remainder of construction in accordance with manufacturer's written instructions.

3.6.1.2 The Air Barrier Assembly

Protect finished portions of the air barrier assembly from damage during ongoing application and throughout the remainder of the construction period in accordance with manufacturer's written instructions. Coordinate timing of installation of materials that will cover the air barrier membrane to ensure the exposure period does not exceed that recommended by the air barrier manufacturer's written installation instructions. Remove and replace, at no additional cost to the government, membrane products that exceed the manufacturer's allowed exposure limits.

3.6.2 Cleaning

Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and as acceptable to the primary material manufacturer.

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SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation	Accreditation
ABAA QAP	Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM C836/C836M	(2015) High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
ASTM E2178	(2013) Standard Test Method for Air Permeance of Building Materials
ASTM E2357	(2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows,

	Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G M/R

Qualifications of Installer; G M/R

SD-02 Shop Drawings

Fluid-Applied Membrane Air Barrier; G M

SD-03 Product Data

Fluid-Applied Membrane Air Barrier

Transition Membrane

Primers, Adhesives, and Mastics

Reinforcement

Safety Data Sheets

SD-04 Samples

Fluid-Applied Membrane Air Barrier Mockup; G R

SD-06 Test Reports

Capillary Moisture Test; G M

Field Peel Adhesion Test; G M

Flame Propagation of Wall Assemblies; G M

Flame Spread and Smoke Developed Index Ratings; G M

Site Inspections Reports; G M

SD-07 Certificates

Fluid-Applied Membrane Air Barrier

Transition Membrane

Qualifications of Manufacturer

Qualifications of Installer

SD-08 Manufacturer's Instructions

Fluid-Applied Membrane Air Barrier

Transition Membrane

Primers, Adhesives, and Mastics

1.4 MISCELLANEOUS REQUIREMENTS

For fluid-applied membrane air barriers provide the following:

1.4.1 Shop Drawings

Submit fluid-applied membrane air barrier shop drawings showing locations and extent of barrier assemblies, transition membranes, details of all typical conditions, intersections with other envelope assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.4.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

1.4.3 Mockup

Provide a mockup of the fluid-applied membrane air barrier. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 5 square meters. Include all components specified as representative of the complete system. Notify the Contracting Officer a

minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

1.4.4 Test Reports

Submit test reports indicating that capillary moisture tests and field peel adhesion tests on all substrate materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier materials tested in accordance with ASTM E84.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight.

1.6 CAPILLARY MOISTURE TEST

Perform a capillary moisture test by plastic sheet method in accordance with ASTM D4263 on the construction mockup and substrate materials. Perform test after curing period as recommended by the air barrier manufacturer. Record mode of failure and area which failed in accordance with ASTM D4263. Once the air barrier material manufacturer has established a minimum adhesion or moisture level for the product on the particular substrate, indicate on the inspection report whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion or moisture value for their product and substrate combination, the inspector must record actual values.

1.7 QUALITY ASSURANCE

1.7.1 Qualifications of Manufacturer

Submit documentation verifying that manufacturer of fluid-applied membrane air barrier is currently accredited by the Air Barrier Association of America (ABAA Accreditation https://www.airbarrier.org/).

1.7.2 Qualifications of Installer

Submit documentation verifying that installers of the fluid-applied membrane air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (https://www.airbarrier.org/qap/).

1.8 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a minimum, construction and testing of construction mock up, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the fluid-applied membrane air barrier.

1.9 ENVIRONMENTAL CONDITIONS

1.9.1 Temperature

Install fluid-applied membrane air barrier within the range of ambient and substrate temperatures as recommended in writing by the fluid-applied membrane air barrier manufacturer. Do not apply fluid-applied membrane air barrier to a damp or wet substrate. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

1.9.2 Exposure to Weather

Protect fluid-applied membrane air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

PART 2 PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

Provide a fluid-applied, vapor permeable, air barrier. This barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane with thru-wall flashing to discharge incidental condensation and water penetration to the exterior of the building enclosure. Provide products suitable for use within temperature ranges specified by manufacturer for the location of the project.

2.1.1 Physical Properties

a. Air Permeance (ASTM E2178): less than 0.02 L per s-m2 at 75 Pa.

b. Air Leakage (ASTM E2357, ASTM E283): in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM Less than 0.2 L per s-m2 at 75 Pa at 25 mm.

c. Tensile Strength (ASTM D412): Not less than 0.95 MPa.

d. Elongation (ASTM D412): Not less than 300 percent.

e. Low temperature Flexibility and Crack Bridging (ASTM C836/C836M): Pass at minus 26 degrees C.

f. Solids by Volume: minimum 50 percent.

g. Flame propagation of wall assemblies (NFPA 285): Pass

h. Surface Burning Characteristics (ASTM E84):

(1) Flame Spread Index Rating not higher than 75.

(2) Smoke Developed Index Rating not higher than 150.

i. Resistance to Mold, Mildew and Fungal Growth (ASTM D5590): 0, No growth.

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics, sealants and other accessories as recommended by manufacturer of fluid-applied membrane air barrier for a complete installation.

2.3 TRANSITION MEMBRANE

Provide as specified in Section 07 27 19.01 SELF-ADHERING AIR BARRIERS.

2.4 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.5 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS.

2.6 REINFORCEMENT

Provide fiberglass mesh tape, or fluid-applied air barrier manufacturer's approved comparable equal product, reinforcement at seams, edges, projections and penetrations. Reinforce all joints exceeding 6 mm with fiberglass mesh.

PART 3 EXECUTION

3.1 EXAMINATION

Before installing fluid-applied membrane air barrier, examine substrates, areas, and conditions under which fluid-applied membrane air barrier assemblies will be applied, with installer present, for compliance with requirements. Ensure the following conditions are met:

a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes.

b. Concrete and masonry surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions. Do not proceed with installation until after minimum concrete curing period recommended by fluid-applied membrane air barrier manufacturer.

c. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full flush.

d. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.

e. Verify sealants used in substrates, and in joints between substrates, are compatible with fluid-applied membrane air barrier.

3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for fluid-applied membrane air barrier application.

a. Remove dust, dirt and other contaminants from joints and cracks before coating surfaces.

b. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through fluid-applied membrane air barrier.

c. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under transition membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.

d. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.

e. For exterior sheathing substrates, ensure that exterior sheathing is stabilized, with corners and edges fastened with appropriate screws. Treat all joints in accordance with the air barrier manufacturer's instructions prior to application of air barrier material. Allow sufficient time for joint treatments to fully cure before application of transition membranes and fluid-applied membrane air barrier.

f. For concrete and masonry substrates, fill all voids and holes, particularly in mortar joints, with non-shrinking grout.

g. Mask off and cover adjacent surfaces to protect from spillage and overspray.

3.3 INSTALLATION

3.3.1 Installation of Transition Membrane

Install transittion membrane materials in accordance with the details on the drawings, Section 07 27 19.01 SELF-ADHERING AIR BARRIERS, and the following:

a. Install transition membrane at all required locations prior to installation of the fluid-applied membrane air barrier.

b. Verify transition membrane is fully adhered to substrate and that its surface is clean, dry and wrinkle free prior to installation of the fluid-applied membrane air barrier.

c. Verify transition membrane completely covers all transition areas and will provide continuity of the finished fluid-applied membrane air barrier without gaps or cracks.

3.3.2 Installation of Flashing

Counterflash upper edge of thru-wall flashing and fluid-applied air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.3.3 Installation of Fluid-Applied Membrane Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

a. Apply fluid-applied membrane air barrier in single or dual coat application by spray or roller. Apply fluid-applied membrane air barrier within manufacturer's recommended temperature range for application.

b. Apply fluid-applied membrane air barrier at rate recommended by manufacturer to yield a wet film thickness of 2.4 mm.

c. Apply fluid-applied membrane air barrier around all penetrations ensuring a complete and continuous air barrier. Lap fluid-applied membrane air barrier a minimum of 75 mm over transition membrane to seal leading edge.

d. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, HVAC assemblies, plumbing and electrical assemblies, doors, windows, louvers, and other assemblies penetrating the fluid-applied membrane air barrier with a termination sealant recommended by the fluid-applied membrane air barrier manufacturer.

e. Notify the Contracting Officer and Testing Agency upon completion of fluid-applied membrane air barrier installation. Air barrier materials and assemblies must remain exposed until tested and inspected by the ABAA.

f. Do not allow materials to come in contact with chemically incompatible materials.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (https://www.airbarrier.org/qap/), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, and this section.

a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written inspection reports to the Contracting Officer within five working days of the inspection and test being performed.

b. If the inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

3.4.2 Field Peel Adhesion Test

Perform a field peel adhesion test on a construction mockup. Test the applied product for adhesion in accordance with manufacturer's recommendations. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D4541. When the manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report must indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, the inspector must record actual values.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect fluid-applied membrane air barrier assemblies from damage during application and remainder of construction in accordance with manufacturer's written instructions.

Coordinate installation, testing, and inspection procedures to ensure exposure period does not exceed that recommended by the product manufacturer. Remove and replace, at no additional cost to the government, membrane products that exceed manufacturer's allowed exposure limits.

3.5.2 Cleaning of Adjacent Surfaces

Clean excess product from adjacent construction using cleaning agents and procedures as recommended in writing by the manufacturer of each type of affected construction and as acceptable to same.

3.6 CLEANUP OF SPILLS

Conduct cleanup of uncured product spillage in accordance with manufacturer's written safe handling instructions.

-- End of Section --

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SECTION 07 54 19
POLYVINYL-CHLORIDE ROOFING
02/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI ES-1	(2003) Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.24	(2014) Roofing - Safety Requirements of Low-Sloped Roofs

ASTM INTERNATIONAL (ASTM)

ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4434/D4434M	(2015) Standard Specification for Poly(Vinyl Chloride) Sheet Roofing
ASTM D6754/D6754M	(2010) Standard Specification for Ketone Ethylene Ester Based Sheet Roofing
ASTM E108	(2011) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	(2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 3619	(2004) Quality Control Guidelines for Application of Polymer-Modified Bitumen Roofing

NRCA 3740 (2005) The NRCA Waterproofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1 (2014) Performance Standard for Retrofit Drains

UNDERWRITERS LABORATORIES (UL)

UL 790 (2004; Reprint Jul 2014) Standard Test Methods for Fire Tests of Roof Coverings

1.2 SUMMARY

Adhered polyvinyl-chloride (PVC) roof membrane system applied over insulation recovery board PVC membrane roofing manufacturer-accepted substrate.

1.3 ASSEMBLY REQUIREMENTS

Provide roofing membrane sheet widths consistent with membrane attachment methods and wind uplift requirements, and as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Provide membrane which is free of defects and foreign material. Coordinate flashing work to permit continuous roof-surfacing operations. Install insulation and weatherproofed planned sections on the same day.

1.3.1 Fire Resistance

Complete roof system assembly:

a. Class A rated in accordance with ASTM E108, FM 4470, or UL 790; and

b. Be listed as Class I roof deck construction in FM APP GUIDE.

FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.3.2 Wind Uplift Resistance

Provide a complete roof system assembly that is rated and installed to resist wind loads indicated and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems, except as approved by the Contracting Officer. Submit Engineering calculations, signed, sealed, and dated by a Registered Engineer validating the wind resistance per ASCE 7, and ANSI/SPRI ES-1 of non-rated roof system. Base wind uplift measurements on a design wind speed as indicated on drawings in accordance with ASCE 7 and other applicable building code requirements.

1.3.3 Solar Reflectance Index (SRI)

SRI measures the roof's ability to reject solar heat, defined such that a standard black (reflectance 0.05, emittance 0.90) is 100. Use roofing materials having minimum appropriate SRI for more than 75 percent of roof surface (low slope (less than 2:12) SRI greater than 78; high slope (greater than 2:12) SRI greater than 29).

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G M

Roof Plan; G M

SD-03 Product Data

PVC Roofing Membrane

Bonding Adhesive

Flashing

Membrane Fasteners and Plates

Pre-Manufactured Accessories

Water Cutoffs

Information Card

SD-05 Design Data

Wind Uplift Resistance; G M

SD-07 Certificates

Qualification of Manufacturer

Qualifications of Applicator

Qualification of Engineer of Record

Wind Uplift Resistance

Fire Resistance classification

Minimum Polymer Thickness

Sample Warranty

SD-08 Manufacturer's Instructions

Application Method

Membrane Flashing

Perimeter Attachment

Auxiliary Fasteners

Pre-Manufactured Accessories

Cold Weather

SD-11 Closeout Submittals

Warranty; G M/R

Information Card; G M/R

Instructions to Government Personnel; G M/R

1.5 QUALITY ASSURANCE

1.5.1 Qualification of Manufacturer

Polyvinyl-Chloride sheet roofing system manufacturer must have a minimum of 10 years experience in manufacturing PVC roofing products.

1.5.2 Qualifications of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the PVC sheet roofing system manufacturer and have a minimum of five years' experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of five projects, within the previous three years, of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project.

1.5.3 Qualification of Engineer of Record

Engineer of Record must be currently licensed within the jurisdiction of the project.

1.5.4 Conformance and Compatibility

Provide an entire roofing and flashing system that is in accordance with specified and indicated requirements, including fire and wind resistance.

1.5.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

a. Drawings, including roof plan, specifications and submittals related to the roof work. Field inspection and verification of all existing conditions, including all fire safety issues, existing structure, and existing materials, including concealed combustibles, which may require additional protection during installation.

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, and roofing substrate, the name of the manufacturer's technical representatives,

the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative to roof manufacturer;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control(NRCA 3619) plan for the roof system installation;

f. Safety requirements.

The conference must be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, designated safety personnel trained to enforce and copy with ASSP A10.24, and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.6 DETAIL DRAWINGS

Submit roof plan depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, location of perimeter half-sheets, spacing of perimeter, corner, and infield fasteners, as applicable. Provide drawings that reflect the project roof plan of each roof level and conditions indicated. Submit bids with approved detail drawings and specifications approved and furnished by the PVC membrane manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Delivery

Deliver materials in the manufacturer's original, unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification number, the container must bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.7.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 10 degrees C for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be

installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

a. Maintain a minimum distance of 10.67 meters for all stored flammable materials, including materials covered with shrink wraps, craft paper or tarps from all torch/welding applications.

b. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.7.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.8 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 4.5 degrees C, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

1.9 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing in accordance with NRCA 3740, are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Apply roofing immediately following application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.10 WARRANTY

Provide roof system material and workmanship warranties. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, and has a minimum duration of 20 years. Submit sample certificate.

1.10.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year, no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, or shows evidence of excessive weathering due

to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.10.2 Roofing System Installer Warranty

The roof system installer must warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.10.3 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the manufacturer warranty for the remainder of the manufacturer warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 PVC Roof Membrane

Provide a minimum polymer thickness 1.8 mm reinforced PVC as specified herein. Provide PVC system capable of obtaining 20 year warranties and as listed in the applicable wind uplift and fire rating classification listings.

Submit Data as required by Section 07 22 00 ROOF AND DECK INSULATION together with requirements of this section. Provide data that includes written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided by and warranted under the full system guarantee of the roof membrane manufacturer.

a. Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Provide materials free of defects and suitable for the service and climatic conditions of the installation. Provide warranted roof system in which all components are sourced from the PVC roof membrane manufacturer, including but not limited to all insulation, coverboards, accessories, adhesives and edge metal.

b. For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior

display at roof access point, or a photoengraved 1 mm thick aluminum card for exterior display. Provide card that is 215 by 275 mm minimum. On the information card identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing Contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

2.1.2 Bonding Adhesive

Provide PVC membrane manufacturer's recommended adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of PVC membrane materials to acceptable insulation, wood, metal, concrete or other acceptable substrate materials. Do not use bonding adhesive to bond membrane materials to each other.

2.1.3 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.4 Membrane Flashing

Provide membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, of a minimum polymer thickness 1.8 mm reinforced PVC for 20 year warranties, and utilized as recommended and supplied by the roof membrane manufacturer or minimum 1.8 mm thick reinforced PVC roof membrane and flashings for 20 year warranties. Submit certification from PVC membrane manufacturer that the proposed PVC membrane roofing product meets the minimum polymer thickness specified.

2.1.5 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended and supplied by the PVC roof membrane manufacturer and meeting the requirements of FM 4470 and FM RoofNav (www. roofnav.com) or FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. Fasteners and plates to be supplied and warranted for the substrate type(s) by PVC membrane manufacturer and recommended by PVC membrane manufacturer's printed data.

2.1.5.1 Stress Plates, Bar or Rail for Fasteners

Utilize corrosion-resistant stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470. Stress plates to be supplied by PVC roof membrane manufacturer. Form stress plates to prevent dishing or cupping. Manufacturer-supplied anchoring bar or rails may be utilized for high wind conditions.

2.1.5.2 Auxiliary Fasteners

Provide corrosion resistant screws, nails, or anchors suitable for intended attachment purpose and be recommended and supplied for use by the PVC roof membrane manufacturer.

2.1.6 Pre-manufactured Accessories

Provide pre-manufactured accessories shall be manufacturer's standard for intended purpose, must comply with applicable specification section, be compatible with the membrane roof system and approved for use and supplied by the PVC roof membrane manufacturer.

2.1.7 PVC Walk Tread

Scrim reinforced 2.4 mm inch thickness PVC membrane with a textured surface, compatible with and supplied by manufacturer of the PVC roof membrane.

2.1.8 Roof Insulation

Provide insulation system and facer material compatible with membrane application specified and be approved and supplied by the PVC membrane roof manufacturer and as specified in Section 07 22 00 ROOF AND DECK INSULATION.

2.1.9 Wood Products

As specified in Section 06 10 00 ROUGH CARPENTRY, except that fire retardant treated materials must not be in contact with PVC membrane or PVC accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

2.2 Reinforced, PVC Membrane

Provide reinforced polyvinyl chloride (PVC) membrane containing fibers or scrim, and complying with ASTM D4434/D4434M, Type II, Grade I, or ASTM D6754/D6754M, and in all cases provide 1.8 mm minimum thickness for adhered application. Not withstanding the ASTM standards referenced, provide reinforced PVC roof membranes having the minimum, labeled thickness specified. PVC membrane thickness specified herein is exclusive of backing material on the bottom of fleece-backed membrane. Provide principal polymer used in manufacture of the membrane sheet as PVC, with width and length of PVC membrane roofing sheet consistent with membrane attachment methods and wind uplift requirements, and sheet size as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Maximum reinforced PVC membrane roofing sheet dimensions to be the maximum width obtainable from PVC membrane roof manufacturer in order to minimize seams in the field of the roof.

PART 3 EXECUTION

3.1 CONCRETE SURFACE DRYNESS

Prior to installing any roof system on a concrete deck, including application of insulation or membrane materials, conduct a test for surface dryness in accordance with ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of

plastic sheet after 24 hours.

3.2 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Do not install items that show visual evidence of biological growth.

b. Drains, curbs, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

c. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

d. Substrate is sloped to provide positive drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.

g. Pressure-preservative treated wood nailers are fastened in place at openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. Surface-applied nailers are the same thickness as the roof insulation.

h. PVC materials are not in contact with fire retardant treated wood, except as approved by the PVC membrane roof manufacturer and Contracting Officer.

i. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 6 mm in width. Insulation is attached as specified in Section 07 22 00 ROOF AND DECK INSULATION. Insulation is being roofed over on the same day the insulation is installed.

3.3 APPLICATION METHOD

Apply entire PVC membrane roofing utilizing adhered application method. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Submit instructions including pattern and frequency of mechanical attachments required in the field for roof, corners, and perimeters to provide for the specified wind resistance

3.3.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the material manufacturer's printed application instructions. Do not thin liquid materials or cleaners used for cleaning PVC sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life

period. Store adhesives at 15 to 27 degrees C prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some thermoplastic sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.

d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane.

e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.

g. Do not use equipment with sharp edges which could puncture the PVC membrane roofing sheet.

h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

3.3.2 PVC Roofing Membrane

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Provide and install only felt-backed membrane directly on concrete deck or other hard surface which may otherwise damage the membrane, absent the felt backing. Do not place non-felt-backed PVC membrane roofing sheet directly on concrete deck or other hard surface which may damage the membrane. Provide membrane overlap of a minimum of 75 mm at sides for adhered applications and 140-180 mm for mechanically fastened applications and minimum 100 mm at ends. Direction of laps must allow water to flow over and not against the lap. Install membrane joints that are free of wrinkles and fishmouths. During the day of installation, probe the entire length of hot-air-welded seams and correct any deficiencies. Reweld defective areas. Cut out any fishmouths, or damaged areas and cover the area with membrane using a continuous hot-air-welded seam on all sides. Probe test repairs for continuity. Hot-air-welded seams are to be accomplished in accordance with the PVC membrane roofing manufacturer's published requirements.

3.3.2.1 Nailing

Fasten membrane to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, stagger nails on 100 mm centers maximum; stagger screws for sheet metal on 200 mm centers maximum; and install rows of fasteners at least 13 mm from edges of sheet metal.

3.3.2.2 Flashing

Flash all roof edges, projections through the roof and changes in roof planes. Seal the seam a minimum of 75 mm beyond the fasteners which attach the membrane to nailers. Secure the installed flashing at the top of the flashing a maximum of 300 mm on centers under the counterflashing or cap. Where possible, install prefabricated components for pipe seals

and flashing accessories.

3.3.2.3 Expansion Joints

Cover expansion joints using Prefabricated covers or elastomeric flashing in accordance with the recommendations of the manufacturer.

3.3.2.4 Cutoffs

If work is terminated prior to weatherproofing the entire roof, seal the membrane to the roof deck. Also, seal flutes in metal decking along the cutoff edge. Pull the membrane free or cut to expose the insulation when resuming work and remove the cut insulation sheets used for fill-in. Do not use asphalt or coal-tar products for sealing.

3.3.2.5 Walkways

Install walkways on a loose-laid pad of the membrane material extending at least.25 mm beyond the walkway material, and as specified by the manufacturer. Do not place stone ballast below or above walkways.

3.3.3 Adhered Membrane Application

Layout membrane and side lap adjoining sheets in accordance with membrane manufacturer's printed installation instructions. Allow for sufficient membrane to form proper membrane terminations. Remove dusting agents and dirt from membrane and substrate areas where bonding adhesives are to be applied. Apply specified adhesive evenly and continuously to substrate and underside of sheets at rates recommended by the roof membrane manufacturer's printed application instructions. When adhesive is spray applied, roll with a paint roller to ensure proper contact and coverage. Do not apply bonding adhesive to surfaces of membrane in seam or lap areas. Allow adhesive to flash off or dry to consistency prescribed by manufacturer before adhering sheets to the substrate. When adhesive is peel and stick release paper-activated, follow manufacturer's printed instructions. Roll each sheet into adhesive slowly and evenly to avoid wrinkles; broom or roll the membrane to remove air pockets and fishmouths and to ensure adequately uniform bonding of sheet to substrate. Form field hot-air-welded laps or seams as specified and ensure that hot-air welded dimension is at width required by the membrane manufacturer's installation instructions. Check all seams and continuous hot-air-weld of all seams and lap seals.

3.3.4 Perimeter Attachment

Adhesive bond or mechanically secure roof membrane sheet at roof perimeter in a manner to comply with wind resistance requirements and in accordance with membrane manufacturer's printed application instructions. When adhesively bonding a mechanically fastened system in perimeter areas, the perimeter boundary of the adhesive bond must be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

3.3.5 Securement at Base Tie-In Conditions

Mechanically fasten the roof membrane at penetrations, at base of curbs and walls, and at all locations where the membrane turns and angles greater than 4 degrees (1:12). Space fasteners a maximum of 300 mm on center, except where more frequent attachment is required to meet

specified wind resistance or where recommended by the roof membrane manufacturer. Cover over fasteners with a layer of flashing material. Hot-air-weld all seams of flashing material as recommended by the roof membrane manufacturer's printed data.

3.3.6 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flashed with PVC membrane flashing materials.

3.3.6.1 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories, or isolated paver block, are set on the membrane, adhere reinforced membrane or walkpad material, as recommended by the roof membrane manufacturer, to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.4 FLASHINGS

Provide flashings in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

3.4.1 General

Provide a one-ply flashing membrane, as specified for the system used, and install immediately after the roofing membrane is placed and prior to finish coating where a finish coating is required. Flashings must be stepped where vertical surfaces abut sloped roof surfaces. Provide sheet metal reglet in which sheet metal cap flashings are installed of not more than 400 mm nor less than 200 mm above the roofing surfaces. Exposed joints and end laps of flashing membrane must be made and sealed in the manner required for roofing membrane.

3.4.2 Membrane Flashing

3.4.2.1 Installation

Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize cured PVC membrane flashing and prefabricated accessory flashings to the maximum extent recommended by the roof membrane manufacturer. Limit uncured flashing material to reinforcing inside and outside corners and angle changes in plane of membrane, and to flashing scuppers, pourable sealer pockets, and other formed penetrations or unusually shaped conditions as recommended by the roof membrane manufacturer where the use of cured material is impractical. Extend base flashing not less than 200 mm above roofing surface and as necessary to provide for seaming overlap on roof membrane as recommended by the roof membrane manufacturer.

3.4.2.2 Sealing

Seal flashing membrane for a minimum of 75 mm on each side of fastening device used to anchor roof membrane to nailers. Completely adhere

flashing sheets in place. Seam flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the Contracting Officer. Reinforce all corners and angle transitions by applying uncured membrane to the area in accordance with roof membrane manufacturer recommendations. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 300 mm on center. Install sheet metal flashing over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

3.4.3 Flashing at Roof Drain

Provide a tapered insulation sump into the drain bowl area. Do not exceed tapered slope of (4:12) for unreinforced membrane and (1:12) for reinforced membrane. Provide tapered insulation with surface suitable for adhering membrane in the drain sump area. Avoid field seams running through or within 600 mm of roof drain, or as otherwise recommended by the roof membrane manufacturer. Adhere the membrane to the tapered in the drain sump area. Apply water block mastic and extend membrane sheets over edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Ensure membrane is free of wrinkles and folds in the drain area. Securely clamp membrane in the flashing clamping ring. Ensure membrane is cut to within 20 mm of inside rim of clamping ring to maintain drainage capacity. Do not cut back to bolt holes. Retrofit roof drains must conform to ANSI/SPRI RD-1.

3.5 ROOF WALKPADS

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the roof membrane manufacturer's printed instructions. Provide minimum 150 mm separation between adjacent walkpads to accommodate drainage.

3.6 CORRECTION OF DEFICIENCES

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and provide corrective action recommendations. Perform corrective action as directed by the Contracting Officer.

3.7 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

3.7.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of the roof membrane system in an effective manner. Seal off flutes in metal decking along the cutoff edge. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.7.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.7.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing system. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order. Metering devices are accurate.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

(1) Nailers and blocking are provided where and as needed.

(2) Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(3) The proper number, type, and spacing of fasteners are installed.

(4) Materials comply with the specified requirements.

(5) All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.

(6) Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required, including additional fastening of membrane in corner and perimeter areas as required.

(7) Membrane is properly overlapped.

(8) Membrane seaming is as specified by PVC membrane manufacturer. All seams are checked at the end of each work day.

(9) Applied membrane is inspected and repaired as necessary prior to paver installation.

(10) Membrane is adhered without ridges, wrinkles, kinks, fishmouths.

(11)Installer adheres to specified and detailed application parameters.

(12)Associated flashing's and sheet metal are installed in a timely manner in accord with the specified requirements.

(13)Paver ballast is within the specified weight range.

(14)Temporary protection measures are in place at the end of each work shift.

3.8.2 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of 3 times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections need not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, a report, signed by the manufacturer's technical representative to the roofing Contractor and then to the Contracting Officer within 3 working days. Within the report state the overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.9 CLEAN UP

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.10 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations. Include copies of Safety Data Sheets for maintenance/repair materials.

3.11 ROOF DRAIN TEST

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

-- End of Section --

SECTION 07 55 00

PROTECTED MEMBRANE ROOFING
08/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C578	(2018) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM D448	(2012; R 2017) Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D4751	(2016) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D5034	(2009; R 2017) Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D751	(2006; R 2011) Coated Fabrics

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

PL 109-58	Energy Policy Act of 2005 (EPAct05)

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006; Reprint Nov 2018) UL Standard for Safety Tests for Uplift Resistance of Roof Assemblies
UL 790	(2004; Reprint Jul 2014) Standard Test

Methods for Fire Tests of Roof Coverings

1.2 SYSTEM DESCRIPTION

1.2.1 Wind Uplift Resistance

Wind uplift resistance of the complete roof assembly shall be rated Class I-90 in accordance with UL 580. Submit drawings required for the membrane, modified to include the complete PMR assembly.

1.2.2 Pre-Roofing Conference

After approval of submittals and before performing roofing and insulation installation work, hold a pre-roofing conference to review the following:

a. Drawings, specifications and submittals related to the roof work

b. Roof system components installation

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer

d. Plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing

e. Quality control plan for the roof system installation

f. Safety requirements

Coordinate pre-roofing conference scheduling with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with roof work, and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roof Assembly; G M

SD-07 Certificates

Material and Equipment

Energy Efficiency

Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment

Submit material supplier's or equipment manufacturer's statement that the supplied insulation, filter fabric and membrane materials meet specified requirements. Each certificate shall be signed by an official authorized to certify on behalf of material supplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. Submit certificates of compliance for material and equipment, as specified.

1.4.2 Energy Efficiency

Provide products that meet or exceed the specified energy efficiency requirements of FEMP designated or Energy Star qualified products. Submit documentation certifying that product conforms to PL 109-58 by meeting or exceeding Energy Star or FEMP efficiency requirements as defined at "Energy-Efficient Products" at http://www1.eere.energy.gov/femp/procurement. Indicate Energy Efficiency Rating.

1.4.3 Qualifications

Submit documentation verifying a minimum of 2 years experience with PMR systems and certification by the PMR manufacturer as an approved Installer for the specified PMR system.

1.4.4 Fire Resistance

The completed roof system shall be rated Class A as determined by UL 790 or Class I as determined by FM APP GUIDE. Compliance of each component of the roofing system shall be evidenced by the label or written certification from the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

Store insulation away from areas where welding is being performed or where contact with open flames is possible. Shield insulation from extended exposure to sunlight. Remove materials damaged by moisture from the site. Ballast shall not be stored on the roof.

PART 2 PRODUCTS

2.1 UNDERLAYMENT

Underlayment may be concrete.

2.2 ROOF MEMBRANE

Roof membrane shall be in accordance with Section 07 54 19 POLYVINYL CHLORIDE ROOFING.

2.3 INSULATION ABOVE THE MEMBRANE

Insulation placed above the membrane shall be extruded polystyrene, or

extruded polystyrene with a mortar face. Insulation shall be a standard product of the manufacturer, and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 24 degrees C, and the thickness. Boards shall be marked individually. The thermal resistance of the insulation shall be not less than the R-value shown on the drawings. Insulation shall conform to ASTM C578, Type V, VI or VII and shall be intended by the manufacturer for use above a protected roof membrane. Bottom layer of insulation shall provide drainage paths, mostly parallel to the slope, between insulation and membrane. Top surface of mortar-faced insulation shall be 10 mm thick portland cement latex mortar having minimum properties as follows: specific gravity: 2.0, compressive strength: 20.7 MPa and bond strength to insulation: 69 kPa. Top layer of insulation may have ribbed top surfaces when flat-bottom pavers are used as ballast.

2.4 FILTER FABRIC

Filter fabric shall be either woven or non-woven pervious sheet of long chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride, formed into a pattern with distinct and measurable openings. The filter fabric shall provide an ASTM D4751 Apparent Opening Size (AOS) no finer than the 0.125 mm sieve and no coarser than the 0.212 mm sieve. Edges of fabric shall be selvaged or otherwise finished to prevent raveling. Fabric shall have minimum weight of 102 gms/sq. m and shall conform to the following table:

Property	Test Procedure	Result
Tensile strength	ASTM D5034 Grab test method using 25 mm 1 inch square jaws and a travel rate of 55 mm per sec 12 inches per minute	29 kg/25 mm65 lbs/inch minimum in any principal direciton
Puncture strength	ASTM D751 - Tension testing machine with ring clamp; steel ball replaced with a 8 mm 5/16 inch diameter solid steel cylinder with a hemispherical tip centered within the ring clamp	18 kg40 lbs minimum load

2.5 AGGREGATE BALLAST

Gravel and crushed stone shall conform to ASTM D448, Size 4 and 2, with less than 2 percent that passes through a 10 mm screen. Ballast shall have minimum unit mass of 960 kg/cubic meter as determined by ASTM C29/C29M.

2.6 PAVERS

Concrete pavers shall be air-entrained concrete, minimum 38 mm thick, having 21 MPa minimum compressive strength. Pavers shall be ribbed on the bottom for use over smooth topped insulation and flat on the bottom for use over insulation with ribbed top.

PART 3 EXECUTION

3.1 INSTALLATION

Install roof membrane and flashing in accordance with Sections 07 54 19 POLYVINYL CHLORIDE ROOFING.

3.2 FLOOD TEST

After the membrane and its flashings are installed, and before the insulation is placed above the membrane, plug the drains and flood the roof with water for 24 hours. Leaks shall be remedied before insulation is installed.

3.3 INSULATION

Insulation shall be loose laid on the membrane after the membrane is completed and flood coat (if any) is cool. When required by the manufacturer of the insulation, a slip sheet shall be installed over the membrane. Drainage paths shall be provided between the lower surface of the insulation and the membrane. Most of the drainage paths shall be parallel to the slope of the roof. Unless otherwise specified by the manufacturer, end joints shall be staggered. Joints between boards shall not exceed 6 mm. Insulation shall be installed to within 19 mm of projections and cant strips.

3.4 FILTER FABRIC INSTALLATION

Filter fabric shall be laid loose over insulation, smooth and free of tension and stress. Edges and ends shall be lapped a minimum of 300 mm and extended above the ballast 50 to 75 mm at the perimeter and penetrations. Joints parallel to perimeter will not be permitted within 1.8 meters of the perimeter.

3.5 BALLAST INSTALLATION

Pavers shall be installed where indicated. Pavers above hidden drains shall be marked so that drains may be inspected. Interior roof drains shall be surrounded with gravel or stone graded between 25 and 38 mm to the level of ballast over insulation or to mid-height of drain bonnet, whichever is lower. During placement of aggregate ballast, drains and other openings shall be covered to prevent inadvertent entry of ballast. Ballast buggy wheels are not allowed on the membrane.

3.6 INSPECTION

Establish and maintain an inspection procedure to ensure compliance of the installed roof with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.

b. Verification of compliance of materials before, during, and after installation, proper storage and handling of insulation.

c. Inspection of mechanical fasteners; type, number, length, and spacing.

d. Coordination with other materials, cants, nailers, flashings, and penetrations.

e. Inspection of proper placement of insulation, joint orientation and laps between layers, joint widths and bearing of edges of underlayment on deck.

f. Inspection of proper placement of pavers and amount and leveling of ballast.

Submit procedures for approval, prior to start of roofing work including a checklist of points to be observed. The actual inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - SI	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A308/A308M	(2010) Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A480/A480M	(2018a) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM C1549	(2016) Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
ASTM E1918	(2016) Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
ASTM E1980	(2011) Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
ASTM E408	(2013) Standard Test Methods for Total

	Normal Emittance of Surfaces Using Inspection-Meter Techniques
ASTM E971	(2011) Standard Practice for Calculation of Photometric Transmittance and Reflectance of Materials to Solar Radiation

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal modifications required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Exposed Sheet Metal Coverings; G M

Gutters; G M

Downspouts; G M

Expansion Joints; G M

Gravel Stops and fascia; G M

Splash Pans; G M

Base Flashing; G M

Counterflashing; G M

Flashing at Roof Penetrations and Equipment Supports; G M

Reglets; G M

Scuppers; G M

Copings; G M

Drip Edges; G M

Conductor Heads; G M

Eave Flashing; G M

Recycled Content; G M

SD-04 Samples

Finish Samples; G R

SD-08 Manufacturer's Instructions

Instructions for Installation

Quality Control Plan

SD-10 Operation and Maintenance Data

Cleaning and Maintenance; G R

1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.4.3 Operation and Maintenance Data

Submit detailed instructions for installation and quality control during installation, cleaning and maintenance, for each type of assembly indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide data for each product with recycled content, identifying percentage of recycled content.

2.2 MATERIALS

Furnish sheet metal items in 2400 to 3000 mm lengths. Single pieces less than 2400 mm long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 300 mm legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used, except as follows:

2.2.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascia; cap, valley, steeped, base, and eave flashings and related accessories.

2.2.2 Stainless Steel

Provide in accordance with ASTM A480/A480M, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.2.3 Terne-Coated Steel

Provide in accordance with ASTM A308/A308M, a minimum of 350 by 500 mm with minimum of 18 kilogram coating per double base box. ASTM A308/A308M.

2.2.4 Aluminum Alloy Sheet and Plate

Provide in accordance with ASTM B209M anodized color (to match existing) form alloy, and temper appropriate for use. Provide material not less than 0.813 mm in thickness.

2.2.4.1 Alclad

When fabricated of aluminum, fabricate the following items with Alclad 3003, Alclad 3004, or Alclad 3005, clad on both sides unless otherwise indicated.

a. Gutters, downspouts, and hangers

b. Gravel stops and fascia

c. Flashing

2.2.5 Finishes

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied color coating of polyvinylidene fluoride (PVF2) or approved equal fluorocarbon coating. Dry film thickness of coatings must be 0.020 to 0.033 mm. Color as indicated on the Drawings. Field applications of color coatings are prohibited and will be rejected.

2.2.6 Cool Roof Finishes2.2.6.1 ASHRAE 90.1 Compliance

Provide roof finishes having a minimum 3-year aged solar reflectance of

0.55 when tested in accordance with ASTM C1549 or ASTM E1918, and a minimum 3-year aged thermal emittance of 0.75 when tested in accordance with ASTM E971 or ASTM E408, or, a minimum 3-year aged Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 6.62 W per m2, to comply with ASHRAE 90.1 - SI.

2.2.7 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221M.

2.2.8 Solder

Provide in accordance with ASTM B32, 95-5 tin-antimony.

2.2.9 Reglets

2.2.9.1 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 6 mm and a depth of 30 mm, as approved.

2.2.10 Scuppers

Line interiors of scupper openings with sheet metal. Provide a drip edge at bottom edges with returns of not less than 25 mm against the face of the outside wall at the top and sides. Provide the perimeter of the lining approximately 13 mm less than the perimeter of the scupper.

2.2.11 Conductor Heads

Provide conductor heads and screens in the same material as downspouts. Provide outlet tubes not less than 100 mm long.

2.2.12 Splash Pans

Provide splash pans where downspouts discharge onto roof surfaces and at locations indicated. Unless otherwise indicated, provide pans not less than 600 mm long by 450 mm wide with metal ribs across bottoms of pans. Provide sides of pans with vertical baffles not less than 25 mm high in the front, and 100 mm high in the back.

2.2.13 Copings

Unless otherwise indicated, provide copings in copper sheets, 2400 or 3000 mm long, joined by a 20 mm locked and soldered seam.

2.2.14 Fasteners

Use the same metal as, or a metal compatible with the item fastened. Use stainless steel fasteners to fasten. Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Metal Roofing

3.1.1.1 Standing-seam Method

Make standing seams parallel with slope of roof. Fabricate sheets into long lengths at shop by locking short dimensions together and thoroughly soldering joints thus formed. In applying metal, turn up one edge of course at each side seam at right angles 40 mm. Then install 50 by 75 mm cleats spaced 300 mm apart by fastening one end of each cleat to roof with two 25 mm long nails and folding roof end back over nail heads. Turn end adjoining turned-up side seam up over upstanding edge of course. Turn up adjoining edge of next course 45 mm and abutting upstanding edges locked, turned over, and flattened against one side of standing seam. Make standing seams straight, rounded neatly at the top edges, and stand about 25 mm above roof deck. All sheets must be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA 1793.

3.1.2 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 13 mm hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 450 mm. Confine nailing of flashing to one edge only. Space nails evenly not over 75 mm on center and approximately 13 mm from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Secure flashing at one-half the normal interval to ensure a wind-resistant installation.

3.1.4 Cleats

Provide cleats for sheet metal 450 mm and over in width. Space cleats evenly not over 300 mm on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 50 mm wide by 75 mm long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is

to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pre-tin cleats for soldered seams.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 1.0 mm or less in thickness.

3.1.6 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.6.1 Flat-lock Seams

Finish not less than 20 mm wide.

3.1.6.2 Lap Seams

Finish soldered seams not less than 25 mm wide. Overlap seams not soldered, not less than 75 mm.

3.1.6.3 Loose-Lock Expansion Seams

Not less than 75 mm wide; provide minimum 25 mm movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 3 mm thick bed.

3.1.6.4 Standing Seams

Not less than 25 mm high, double locked without solder.

3.1.6.5 Flat Seams

Make seams in the direction of the flow.

3.1.7 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pre-tin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 1.0 mm or less in thickness with specified sealants. Do not solder aluminum.

3.1.7.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pre-tinned. Seal the joints in aluminum sheets of 1.0 mm or less in thickness with specified sealants. Do not solder aluminum.

3.1.8 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 1.0 mm. Aluminum 1.0 mm or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with

sealant as recommended by the aluminum manufacturer.

3.1.8.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

3.1.8.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 300 mm maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 50 mm from the end of the overlapping sheet.

3.1.9 Protection from Contact with Dissimilar Materials

3.1.9.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.9.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint. Aluminum may be used over concrete construction, provided that required reglets are of stainless steel and aluminum surface in contact with concrete or masonry is coated with bituminous paint or zinc chromate primer.

3.1.9.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.9.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.10 Expansion and Contraction

Provide expansion and contraction joints at not more than 9750 mm intervals for aluminum and at not more than 12 meter intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascia by expansion and contraction joints spaced not more than 3600 mm apart.

3.1.11 Base Flashing

Extend up vertical surfaces of the flashing not less than 200 mm and not less than 100 mm under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 150 mm. Overlap the flashing strips with the previously laid flashing not less than 75 mm. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 150 mm on center with stainless steel anchors. Solder end laps and provide for expansion and contraction. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners.

3.1.12 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 230 to 250 mm above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 75 mm. Fold the exposed edges of counterflashings 13 mm. Provide end laps in counterflashings not less than 75 mm and make it weathertight. Do not make lengths of metal counterflashings exceed 3000 mm. Form flashings to the required shapes before installation. Factory form corners not less than 300 mm from the angle. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into concrete walls not less than 6 mm and extend not less than 50 mm into the walls. Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

3.1.13 Metal Reglets

Keep temporary cores in place during installation. Ensure factory fabricated caulked type or friction type, reglets have a minimum opening of 6 mm and a minimum depth of 30 mm, when installed.

3.1.13.1 Caulked Reglets

Wedge flashing in reglets with lead wedges every 450 mm, caulked full and solid with an approved compound.

3.1.13.2 Friction Reglets

Install flashing snap lock receivers at 600 mm by 600 mm on center maximum. When flashing has been inserted the full depth of the slot, caulk the slot, lock with wedges, and fill with sealant.

3.1.14 Gravel Stops and fascia

Prefabricate in the shapes and sizes indicated and in lengths not less than 2400 mm. Extend flange at least 100 mm onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascia after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascia on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails

38 mm long spaced not more than 75 mm on center, in two staggered rows.

3.1.14.1 Edge Strip

Hook the lower edge of fascia at least 20 mm over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 150 mm maximum on center. Where fastening is made to concrete or masonry, use screws spaced 300 mm on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 2 mm thick compatible spacer or washers.

3.1.14.2 Joints

Leave open the section ends of gravel stops and fascia 6 mm and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 100 mm set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascia in accordance with the manufacturer's printed instructions and details.

3.1.15 Metal Drip Edges

Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 75 mm and secure with compatible nails spaced not more than 250 mm on center along upper edge.

3.1.16 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 20 by 5 mm of material compatible with gutter. Fabricate gutters in sections not less than 2400 mm. Lap the sections a minimum of 25 mm in the direction of flow or provide with concealed splice plate 150 mm minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof. Support gutters on adjustable hangers spaced not more than 750 mm on center. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from compatible metals.

3.1.17 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the concrete, masonry or steel substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide end joints to telescope not less than 13 mm and lock longitudinal joints. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than 25 mm away from walls. Fasten to the walls at top, bottom, and at an

intermediate point not to exceed 1500 mm on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.17.1 Terminations

Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.18 Scuppers

Extend the scupper liner through and project outside of, the wall it penetrates to form a bottom drip edge against the face of the wall. Fold outside edges under 13 mm on all sides. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.1.19 Conductor Heads

Set the depth of the top opening equal to two-thirds of the width or the conductor head. Flat-lock solder seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 50 mm wider than the scupper. Attach conductor heads to the wall with masonry fasteners. Securely fasten screens to heads.

3.1.20 Splash Pans

Install splash pans lapped with horizontal roof flanges not less than 100 mm wide to form a continuous surface. Bend the rear flange of the pan to contour of can't strip and extend up 150 mm under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

3.1.21 Eave Flashing

One piece in width, applied in 2400 to 3000 mm lengths with expansion joints spaced as specified in paragraph EXPANSION AND CONTRACTION. Provide a 20 mm continuous fold in the upper edge of the sheet to engage cleats spaced not more than 250 mm on center. Locate the upper edge of flashing not less than 450 mm from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with 25 mm flat locked joints with cleats that are 250 mm on center.

3.1.22 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 375 by 455 mm. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.23 Expansion Joints

Provide expansion joints for roofs, walls as indicated on drawings.

3.1.23.1 Roof Expansion Joints

Provide stainless steel expansion joint cover with slip joints as indicated on drawings.

Make the outer edge projection not less than 25 mm for flashing on one side of the expansion joint and be less than the width of the expansion joint plus 25 mm for flashing on the other side of the joint. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. Joints are specified in Table II.

3.1.23.2 Wall Expansion Joints

Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

3.1.24 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck. Goose-necks, rain hoods, power roof ventilators.

3.1.25 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 75 mm on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 50 mm. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 100 mm roof flange in bituminous plastic cement and nailed 75 mm on center. Extend sleeve a minimum of 200 mm above the roof deck and lapped a minimum of 75 mm by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.2 PAINTING

Touch ups in the field may be applied only after metal substrates have been cleaned and pretreated in accordance with manufacturer's written instructions and products.

Field-paint sheet metal for separation of dissimilar materials.

3.2.1 Aluminum Surfaces

Clean with solvent and apply one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool,

fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper kilograms per square meter	Aluminum, mm	Stainless Steel, mm	Terne-Coated Stainless Steel, mm	Zinc-Coated Steel, mm
Building Expansion Joints					
Cover	4.9	0.81	0.38	0.38	0.6
Waterstop-bellows or flanged, U-type.	4.9	-	0.38	0.38	-
Covering on minor flat, pitched or curved surfaces	6.125	1.02	0.46	0.46	-

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	Copper kilograms per square meter	Aluminum, mm	Stainless Steel, mm	Terne-Coated Stainless Steel, mm	Zinc-Coated Steel, mm
Downspouts and leaders	4.9	0.81	0.38	0.38	0.6
Downspout clips and anchors	-	1.02 clip 3.175 anchor	-	-	-
Downspout straps, 50 mm	14.7 (a)	1.52	1.27	-	-
Conductor heads	4.9	0.81	0.38	0.38	-
Scupper lining	6.125	0.81	0.38	0.38	-
Strainers, wire diameter or gage	4.0 gage	3.66 diameter	2.77 diameter	-	
Flashings:					
Base	6.125	1.02	0.46	0.46	0.6
Cap (Counter-flashing)	4.9	0.81	0.38	0.38	0.5
Eave	4.9	-	0.38	0.38	0.6
Spandrel beam	3.1	-	0.25	0.25	-
Bond barrier	4.9	-	0.38	0.38	-
Stepped	4.9	0.81	0.38	0.38	-
Valley	4.9	0.81	0.38	0.38	-
Roof drain	4.9 (b)				
Pipe vent sleave (d)					
Coping	4.9	-	-	-	-
Gravel stops and fascia:					
Extrusions	-	1.91	-	-	-
Sheets, corrugated	4.9	0.81	0.38	0.38	-
Sheets, smooth	6.125	1.27	0.46	0.46	0.6

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper kilograms per square meter	Aluminum, mm	Stainless Steel, mm	Terne-Coated Stainless Steel, mm	Zinc-Coated Steel, mm
Edge strip	7.35	1.27	0.635	-	-
Gutters:					
Gutter section	4.9	0.81	0.38	0.38	0.6
Continuous cleat	4.9	0.81	0.38	0.38	0.6
Hangers, dimensions	25 mm by 3 mm (a)	25 mm by 2 mm (c)	25 mm by 1 mm	-	-
Joint Cover plates (See Table II)	4.9	0.81	0.38	0.38	0.6
Reglets (c)	3.1	-	0.25	0.25	-
Splash pans	4.9	1.02	0.46	0.46	-

(a) Brass.

(b) May be lead weighing 19.6 kilograms per square meter.

(c) May be polyvinyl chloride.

(d) 12.25 kilogram minimum lead sleeve with 100 mm flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	30 mm single lock, standing seam, cleated	30 mm single lock, standing	--
Flashings			
Base	25 mm 75 mm lap for expansion joint	25 mm flat locked, soldered; sealed; 75 mm lap for expansion joint	Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound.
Cap-in reglet	75 mm lap	75 mm lap	Seal groove with joint sealing compound.
Reglets	Butt joint	--	Seal reglet groove with joint sealing compound.
Eave	25 mm flat locked, cleated. 25 mm loose locked, sealed expansion joint, cleated.	25 mm flat locked, locked, cleated 25 mm loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	75 mm lap	75 mm lap	--
Valley	150 mm lap cleated	150 mm lap cleated	--
Edge strip	Butt	Butt	--
Gravel stops:			

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Extrusions	--	Butt with 13 mm space	Use sheet flashing beneath and a cover plate
Sheet, smooth	Butt with 6 mm space	Butt with 6 mm space	Use sheet flashing backup plate.
Sheet, corrugated	Butt with 6 mm space	Butt with 6 mm space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	40 mm lap, riveted and soldered	25 mm flat locked riveted and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.
(a) Provide a 75 mm lap elastomeric flashing with manufacturer's recommended sealant.			
(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.			

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SECTION 07 84 00

FIRESTOPPING
05/10

PART 1 GENERAL

1.1 SUMMARY

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	(2019) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E699	(2009) Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components
ASTM E814	(2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM E1399/E1399M	(1997; R 2017) Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E1966	(2015; R 2019) Standard Test Method for

	Fire-Resistive Joint Systems
ASTM E2174	(2014b) Standard Practice for On-Site Inspection of Installed Fire Stops
ASTM E2307	(2015a) Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus
ASTM E2393	(2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

FM GLOBAL (FM)

FM 4991	(2013) Approval of Firestop Contractors
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2015) International Building Code

UNDERWRITERS LABORATORIES (UL)

UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 1479	(2015) Fire Tests of Through-Penetration Firestops
UL 2079	(2004; Reprint Dec 2014) Tests for Fire Resistance of Building Joint Systems
UL Fire Resistance	(2014) Fire Resistance Directory

1.3 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials. at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office

that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping System; G M

SD-03 Product Data

Firestopping Materials

SD-06 Test Reports

Inspection; G M

SD-07 Certificates

Inspector Qualifications

Firestopping Materials

Installer Qualifications

1.5 QUALITY ASSURANCE

1.5.1 Installer

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training, and retain proof of certification for duration of firestop installation.

1.5.2 Inspector Qualifications

The inspector shall meet the criteria contained in ASTM E699 for agencies involved in quality assurance and shall have a minimum of two years' experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected. Include in the qualifications submittal a notarized statement assuring compliance with the requirements stated herein.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 FIRESTOPPING SYSTEM

Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

2.2 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.2.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.2.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

2.2.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.2.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SUMMARY, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Fire resistance ratings shall be as follows:

2.2.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions

F Rating = Rating of wall or partition being penetrated.

2.2.3.1.2 Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the Ceiling Membrane of Roof-Ceiling Assemblies

Where the penetrating item is outside of a wall cavity the F rating must be equal to the fire resistance rating of the floor penetrated, and the T rating shall be in accordance with the requirements of ICC IBC.

2.2.3.1.3 Penetrations of Fire and Smoke Resistance Rated Walls, Floors, Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies

F Rating = Rating of wall or partition being penetrated.

2.2.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SUMMARY, and gaps such as those between floor slabs and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E119, ASTM E1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E1399/E1399M or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 100 mm or more in any direction must be capable of supporting the same load as the floor is designed to support or be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products and devices as indicated.

3.2.3.1 Re-Enterable Devices

Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <10 cfm/sf at 0 percent to 100 percent visual fill.

3.2.3.2 Re-Sealable Products

Provide firestopping pre-manufactured modular products, containing self-sealing intumescent inserts. Firestopping products shall allow for cable moves, additions or changes. Devices shall be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants.

3.3 INSPECTION

For Navy projects, install one of each type of penetration and have it inspected and accepted by the NSA Bahrain Fire Inspector OR a Certified Inspector from the Manufacturer prior to the installation of the remainder of the penetrations. At this inspection, the manufacturer's technical representative of the firestopping material shall be present. For all projects, the remainder of the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. The inspector must inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.1 Inspection Standards

Inspect all firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results to be submitted.

3.3.2 Inspection Reports

Submit inspection report stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

-- End of Section --

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SECTION 07 92 00

JOINT SEALANTS
08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1193	(2013) Standard Guide for Use of Joint Sealants
ASTM C1521	(2013) Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
ASTM C734	(2015) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C919	(2012; R 2017) Standard Practice for Use of Sealants in Acoustical Applications
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D217	(2017) Standard Test Methods for Cone Penetration of Lubricating Grease
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond Breakers

Backstops

SD-07 Certificates

Indoor Air Quality For Interior Sealants

1.3 PRODUCT DATA

Include storage requirements, shelf life, curing time, instructions for mixing and application, and accessories. Provide manufacturer's Safety Data Sheets (SDS) for each solvent, primer and sealant material proposed.

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.4.1.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body.

1.5 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 4 and 32 degrees C.

1.6 DELIVERY AND STORAGE

Deliver materials to the jobsite in unopened manufacturers' sealed shipping containers, with brand name, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Handle and store materials in accordance with manufacturer's printed instructions. Prevent exposure to foreign materials or subjection to sustained temperatures exceeding 32 degrees C or lower than 4 degrees C. Keep materials and containers closed and separated from absorptive materials such as wood and insulation.

1.7 QUALITY ASSURANCE

1.7.1 Compatibility with Substrate

Verify that each sealant is compatible for use with each joint substrate in accordance with sealant manufacturer's printed recommendations for each application.

1.7.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed

instructions.

1.7.3 Mock-Up

Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

1.7.4 Adhesion

Provide in accordance with ASTM C1193 or ASTM C1521.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant products that have been tested, found suitable for the particular substrates to which they will be applied.

2.1.1 Interior Sealants

Provide ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide certification or validation of indoor air quality for interior sealants. Location(s) and color(s) of sealant for the following.

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface mounted equipment and fixtures, and similar items.	Match adjacent surface color
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	Match adjacent surface color
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	Match adjacent surface color
d. Joints between edge members for ceiling and adjoining vertical surfaces.	Match adjacent surface color
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	Match adjacent surface color
f. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	Match adjacent surface color

2.1.2 Exterior Sealants

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows.

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b. Joints between new and existing exterior masonry walls.	Match adjacent surface color
c. Masonry joints where shelf angles occur.	Match adjacent surface color
d. Expansion and control joints.	Match adjacent surface color
e. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match adjacent surface color
f. Voids where items pass through exterior walls.	Match adjacent surface color
g. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent surface color
h. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
i. Joints between ends of gravel stops, fascia, copings, and adjacent walls.	Match adjacent surface color

2.1.3 Floor Joint Sealants

ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows.

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Match adjacent surface color
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Match adjacent surface color

2.1.4 Acoustical Sealants

Rubber or polymer based acoustical sealant in accordance with ASTM C919 to have a flame spread of 25 or less and a smoke developed rating of 50 or

less when tested in accordance with ASTM E84. Provide non-staining acoustical sealant with a consistency of 250 to 310 when tested in accordance with ASTM D217. Acoustical sealant must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734.

2.2 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.3 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. Protect adjacent aluminum surfaces from solvents. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent.

3.1.2 Aluminum Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
6 mm (minimum)	6 mm	6 mm
over 6 mm	1/2 of width	Equal to width
For wood, concrete, masonry, stone		
6 mm (minimum)	6 mm	6 mm
over 6 mm to 13 mm	6 mm	Equal to width
over 13 mm to 25 mm	50 mm	16 mm
Over 25 mm	prohibited	

Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is prohibited at metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finished surface on one or both sides of joint cavities to protect adjacent finished surfaces from primer or sealant

smears. Remove masking tape within 10 minutes of joint filling and tooling.

3.3.3 Backstops

Provide backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide joints in specified depths. Provide backstops where indicated and where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in JOINT WIDTH-TO-DEPTH RATIOS Table.

3.3.4 Primer

Clean out loose particles from joints immediately prior to application of. Apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's printed instructions. Do not apply primer to exposed finished surfaces.

3.3.5 Bond Breaker

Provide bond breakers to surfaces not intended to bond in accordance with, sealant manufacturer's printed instructions for each type of surface and sealant combination specified.

3.3.6 Sealants

Provide sealants compatible with the material(s) to which they are applied. Do not use a sealant that has exceeded its shelf life or has jelled and cannot be discharged in a continuous flow from the sealant gun. Apply sealants in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Work sealant into joints so as to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Apply sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply additional sealant, and tool smooth as specified. Apply sealer over sealants in accordance with the sealant manufacturer's printed instructions.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled and no residual tape marks remain.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately remove fresh sealant that has been smeared on adjacent masonry, rub clean with a solvent, and remove solvent residue, in accordance with sealant manufacturer's

printed instructions. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding. Remove resulting debris.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2018) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C578	(2018) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2017) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	(2014) Mineral Fiber Block and Board Thermal Insulation
ASTM D2863	(2017a) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	(2016) Hardware Preparation in Steel Doors and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105	(2016; TIA 16-1) Standard for Smoke Door Assemblies and Other Opening Protectives
NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	(2009) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR 113	(2001; R2006) Standard Practice for Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.11	(2001) Recommended Erection Instructions for Steel Frames
SDI/DOOR A250.3	(2007; R 2011) Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
SDI/DOOR A250.6	(2003; R2009) Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 10C	(2016) UL Standard for Safety Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G M

Recycled Content for Steel Door Product; G M

Frames; G M

Recycled Content for Steel Frame Product; G M

Accessories; G M

Weatherstripping; G M

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of Doors; G M

Schedule of Frames; G M

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6 mm airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Provide exterior doors with top edge closed flush and sealed to prevent water intrusion. Provide doors at 44.5 mm thick, unless otherwise indicated. Provide door material that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel door product.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Standard Duty Doors

SDI/DOOR A250.8, Level 1, physical performance Level C, Model 1 or 2, of size(s) and design(s) indicated and core construction as required by the manufacturer. Provide where shown.

2.1.1.2 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 1 or 2, with core construction as required by the manufacturer for interior doors. Provide sdi/door a250.8, Level 4 physical performance level a, model 2 at all exterior doors. Where vertical stiffener cores are required, the space between the stiffeners must be filled with mineral board insulation.

2.2 ACCESSORIES

2.2.1 Astragals

For interior pairs of fire rated and smoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

2.3 INSULATION CORES

Provide insulating cores of the type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and conforming to:

a. Rigid Cellular Polyisocyanurate Foam: ASTM C591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or

b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or

c. Mineral board: ASTM C612, Type I.

2.4 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 2, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors and mullions, unless otherwise indicated. Provide frame product that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel frame product.

2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.4.2 Mullions and Transom Bars

Provide mullions and transom bars of closed or tubular construction with heads and jambs butt-welded together. Bottom of door mullions must have adjustable floor anchors and spreader connections.

2.4.3 Stops and Beads

Form stops and beads from 0.9 mm thick steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 300 to 400 mm on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.4 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick.

2.4.4.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 2285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111.

2.5 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 takes precedence over details indicated or specified.

2.5.1 Labels

Provide fire doors and frames bearing the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing must be in accordance with NFPA 252 or UL 10C. Provide labels that are metal with raised letters, bearing the name or file number of the door and frame manufacturer. Labels must be permanently affixed at the factory to frames and to the hinge edge of the door. Do not paint door and labels.

2.5.2 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.6 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.7 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.8 FINISHES

2.8.1 Factory-Primed Finish

Thoroughly clean all surfaces of doors and frames then chemically treat and factory prime with a rust inhibiting coating as specified in SDI/DOOR A250.8 , or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.8.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior interior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924Mand ASTM A653/A653M. The coating weight must meet or exceed the minimum requirements for coatings having 122 grams per square meter, total both sides, i.e., ZF120. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

2.8.3 Factory-Applied Enamel Finish

Provide coatings that meet test procedures and acceptance criteria in accordance with SDI/DOOR A250.3. After factory priming, apply two coats of low-gloss enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements must be in accordance with the coating manufacturer's recommendations. Provide finish coat color(s) as indicated on drawings.

2.9 FABRICATION AND WORKMANSHIP

Provide finished doors and frames that are strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Provide molded members that are clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints must be well formed and in true alignment. Conceal fastenings where practicable.

2.9.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

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SECTION 08 33 23

OVERHEAD COILING DOORS
08/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP	(2017) Fundamentals Handbook, I-P Edition

ASME INTERNATIONAL (ASME)

ASME B29.400	(2001; (R 2008) (R 2013) (R 2018)) Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	(2017) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009; R 2015) Standard Practice for

	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2018) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D2000	(2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications
ASTM E330/E330M	(2014) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 1	(2016; SUPP 2016) Motors and Generators
NEMA ST 1	(1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overhead Coiling Doors; G M

Counterbalancing Mechanism; G M

Electric Door Operators; G M

Bottom Bars; G M

Guides; G M

Mounting Brackets; G M

Overhead Drum; G M

Hood; G M

Installation Drawings; G M

SD-03 Product Data

Overhead Coiling Doors

Hardware

Counterbalancing Mechanism

Electric Door Operators

SD-05 Design Data

Overhead Coiling Doors; G M

Hardware; G M

Counterbalancing Mechanism; G M

Electric Door Operators; G M

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G R

Materials; G R

Devices; G R

Procedures; G R

Manufacture's Brochures; G R

Parts Lists; G R

SD-11 Closeout Submittals

Warranty; G M/R

1.3 WARRANTY, OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance Manuals for Overhead Coiling Door. Assembly, including the following items:

a. Materials

b. Devices

c. Hood

d. Electric Door Operators

e. Counterbalancing Mechanism

f. Painting

g. Procedures

h. Manufacturer's Brochures

i. Parts list

Contractor must furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship for not less than two years after completion and acceptance of the project.

Contractor must warrant that upon notification by the Government, he will immediately make good any defects in material, workmanship, and door operation within the same time period covered by the guarantee, at no cost to the Government.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in an adequately ventilated dry location that is free from dirt and dust, water, or other contaminants. Store in a manner that permits easy access for inspection and handling.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Doors to be coiling type, with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated on drawings. Use grease-sealed or self-lubricating bearings for rotating members.

2.1.1 Design Requirements

2.1.1.1 Overhead Coiling Door Detail Shop Drawings

Provide installation drawings for overhead coiling door assemblies which show: elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Show locations of replaceable fusible links on wiring diagrams for power, signal and controls. Include a schedule showing the location of each door with the drawings.

2.1.2 Performance Requirements

2.1.2.1 Wind Loading

Design and fabricate door assembly to withstand the wind loading pressures as indicated on the structural drawings with a maximum deflection of 1/120 of the opening width. Provide test data showing compliance with ASTM E330/E330M. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested. Ensure complete assembly meets or exceeds the requirements of ASCE 7.

2.1.2.2 Operational Cycle Life

Design all portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

2.2 COMPONENTS

2.2.1 Overhead Coiling Doors

2.2.1.1 Curtain Materials and Construction

Provide curtain slats fabricated from Grade A steel sheets conforming to ASTM A653/A653M, with the additional requirement of a minimum yield point of 228 Megapascal Provide sheets, galvanized in accordance with ASTM A653/A653M and ASTM A924/A924M.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Ensure the provided slats are continuous without splices for the width of the door.

Provide slats filled with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within slat faces on interior surface of slats.

2.2.1.2 Insulated Curtains

Form Curtains from manufacturer's standard shapes of interlocking slats. Supply slat system with a minimum R-value of 4 when calculated in accordance with ASHRAE FUN IP. Slats to consist of a polystyrene core not less than 17 mm thick, completely enclosed within metal facings. Ensure the exterior face of slats are the same gauge as specified for curtains. Select an interior face not lighter than 0.56 mm. The insulated slat assembly requires a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E84.

2.2.1.3 Curtain Bottom Bar

Install curtain bottom bars as pairs of angles from the manufacturer's standard steel, stainless and aluminum extrusions not less than 50 by 50 millimeter by 4.8 millimeter Ensure steel extrusions conform to ASTM A36/A36M. Galvanize angles and fasteners in accordance with ASTM A653/A653M and ASTM A924/A924M. Coat welds and abrasions with paint

conforming to ASTM A780/A780M.

2.2.1.4 Locks

Provide end and/or wind locks of Grade B cast steel conforming to ASTM A27/A27M, galvanized in accordance with ASTM A653/A653M, ASTM A153/A153M and ASTM A924/A924M. Secure locks at every other curtain slat.

2.2.1.5 Weather Stripping

Ensure weather-stripping at the door-head and jamb is 3.2 millimeter thick sheet of natural or neoprene rubber with air baffles. Secure weather stripping to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 15.9 millimeter wide and 3.2 millimeter thick.

Ensure threshold weather-stripping is 3.2 millimeter thick sheet natural or neoprene rubber secured to the bottom bars.

Provide weather-stripping of natural or neoprene rubber conforming to ASTM D2000.

2.2.1.6 Locking Devices

Ensure slide bolt engages through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

2.2.1.7 Safety Interlock

Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.2.1.8 Overhead Drum

Fabricate drums from nominal 0.71-mm thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.

2.2.1.9 Slats

No. 5F, 20-gauge, Grade 40 steel, ASTM A653/A653M galvanized steel zinc coating.

2.2.2 Hardware

Ensure all hardware conforms to ASTM A153/A153M, ASTM A307, ASTM F568M, and ASTM A27/A27M.

2.2.2.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated. Provide guides with sufficient depth and strength to retain curtain, and to withstand loading. Ensure curtain operates smoothly. Slot bolt holes for track adjustment.

2.2.2.2 Equipment Supports

Fabricate door-operating equipment supports from the manufacturer's

standard steel shapes and plates conforming to ASTM A36/A36M, galvanized in accordance with ASTM A653/A653M and ASTM A924/A924M. Size the shapes and plates in accordance with the industry standards for the size, weight, and type of door installation.

2.2.2.3 Hood

Provide a hood with a minimum 24-gauge galvanized sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. The hood encloses the curtain coil and counterbalance mechanism.

2.2.3 Counterbalancing Mechanism

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted, around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.2.3.1 Brackets

Provide the manufacturer's standard mounting brackets with one located at each end of the counterbalance barrel conforming to ASTM A48/A48M. Provide brackets of either cast iron or cold-rolled steel.

2.2.3.2 Counterbalance Barrels

Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A53/A53M. Ensure the barrel is of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats. Limit barrel deflection to not more than 2.5 mm per meter of span under full load.

2.2.4 Electric Door Operators

Provide electrical wiring and door operating controls conforming to the applicable requirements of NFPA 70.

Electric door-operator assemblies needs to be the sizes and capacities recommended and provided by the door manufacturer for specified doors. Furnish complete assemblies with electric motors and factory-prewired motor controls, starter, gear reduction units, solenoid-operated brakes, clutch, remote-control stations, manual or automatic control devices, and accessories as required for proper operation of the doors.

Design the operators so that motors may be removed without disturbing the limit-switch adjustment and affecting the emergency auxiliary operators.

Provide a manual operator of crank-gear or chain-gear mechanisms with a release clutch to permit manual operation of doors in case of power failure. Arrange the emergency manual operator so that it may be put into and out of operation from floor level, and its use does not affect the adjustment of the limit switches. Provide an electrical or mechanical device that automatically disconnects the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

The motor and control system shall be selected and provided with all

additional devices required so that only a single point of electrical connection will be needed at the voltage, frequency, and phases as provided in the electrical drawings. Changes required to the electrical system for short-circuit or ground fault protection shall be provided to the Division 26 contractor to be included in their pricing.

2.2.4.1 Door-Operator Types

Provide an operator mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

2.2.4.2 Electric Motors

Provide motors which are the high-starting-torque, reversible, constant-duty electrical type with overload protection of sufficient torque and horsepower to move the door in either direction from any position. Ensure they produce a door-travel speed of not less than 0.2 nor more than 0.3 meter per second without exceeding the horsepower rating.

Provide motors which conform to NEMA MG 1 designation, temperature rating, service factor, enclosure type, and efficiency to the requirements specified.

2.2.4.3 Motor Bearings

Select bearings with bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Pre-lubricate and factory seal bearings in motors less than 375 watts.

Equip motors coupled to worm-gear reduction units with either ball or roller bearings.

Equip bearings in motors 1/2 horsepower or larger with lubrication service fittings. Fit lubrication fittings with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods do not need to be lubricated for a given number of operating hours. Display this information on an appropriate tag or label on the motor with instructions for lubrication cycle maintenance.

2.2.4.4 Motor Starters, Controls, and Enclosures

Provide each door motor with: a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; 120-volt operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein. Ensure control equipment conforms to NEMA ICS 2.

Provide adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position.

2.2.4.5 Control Enclosures

Provide control enclosures that conform to NEMA ICS 6 for general purpose NEMA Type 1.

2.2.4.6 Transformer

Provide a transformer conforming to NEMA ST 1.

2.2.4.7 Safety-Edge Device

Provide each door with a pneumatic safety device extending the full width of the door and located within a U-section neoprene or rubber astragal, mounted on the bottom rail of the bottom door section. Device needs to immediately stop and reverse the door upon contact with an obstruction in the door opening during downward travel and cause the door to return to full-open position. A safety device is not a substitute for a limit switch.

Connect safety device to the control circuit through a retracting safety cord and reel.

2.2.4.8 Remote-Control Stations

Provide interior remote control stations which are full-guarded, momentary-contact three-button, heavy-duty, surface-mounted NEMA ICS 6 type enclosures as specified. Mark buttons "OPEN," "CLOSE," and "STOP." Ensure the "CLOSE" button requires a constant pressure to maintain the closing motion of the door. When the door is in motion and the "STOP" button is pressed, ensure the door stops instantly and remains in the stopped position. From the stopped position, the door may then be operated in either direction.

Provide exterior control stations which are full-guarded, momentary-contact three-button standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosures, key-operated, with the same operating functions as specified herein for interior remote-control stations.

2.2.4.9 Speed-Reduction Units

Provide speed-reduction units consisting of hardened-steel worm and bronze worm gear assemblies running in oil or grease and inside a sealed casing, coupled to the motor through a flexible coupling. Drive shafts need to rotate on ball- or roller-bearing assemblies that are integral with the unit.

Provide minimum ratings of speed reduction units in accordance with AGMA provisions for class of service.

Ground worm gears to provide accurate thread form; machine teeth for all other types of gearing. Surface harden all gears.

Provide antifriction type bearings equipped with oil seals.

2.2.4.10 Chain Drives

Provide roller chains that are a power-transmission series steel roller type conforming to ASME B29.400, with a minimum safety factor of 10 times

the design load.

Heat-treat or otherwise harden roller-chain side bars, rollers, pins, and bushings.

Provide high-carbon steel chain sprockets with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

2.2.4.11 Brakes

Provide 360-degree shoe brakes or shoe and drum brakes. Ensure the brakes are solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

2.2.4.12 Clutches

Ensure clutches are either the 100 millimeter diameter, multiple face, externally adjustable friction type or adjustable centrifugal type.

2.2.4.13 Weather/Smoke Seal Sensing Edge

Provide automatic stop control by an automatic sensing switch within neoprene astragal extending the full width of door bottom bar.

Provide an electric sensing edge device. Ensure the door immediately stops downward travel when contact occurs before door fully closes. Provide a self-monitoring wireless sensing edge connection to the motor operator; eliminating the need for a physical traveling electric cord connection between bottom bar sensing edge device and motor operator. Supervised system alters normal door operation; preventing damage, injury or death due to an inoperable sensing edge system.

2.2.5 Factory Applied Finish

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 INSTALLATION

Install overhead coiling door assembly, anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, ensure doors are free from all distortion.

Install overhead coiling doors, motors, hoods, and operators at the mounting locations as indicated for each door in the contract documents and as required by the manufacturer.

Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.1.1 Factory Applied Finish

Provide factory applied finish on steel doors and frames. Protect weather stripping from paint. Ensure finishes are free of scratches or other blemishes.

3.2 ADJUSTING AND CLEANING

3.2.1 Acceptance Provisions

After installation, adjust hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to manufacturer's written instructions.

Test the door opening and closing operation when activated by controls or alarm-connected fire-release system. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Reset door-closing mechanism after successful test.

Test and make final adjustment of new doors at no additional cost to the Government.

3.2.1.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, examine, lubricate, test, and re-adjust doors as required for proper operation.

3.2.1.2 Cleaning

Clean doors in accordance with manufacturer's approved instructions.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Warranty

Furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship for not less than two years after completion and acceptance of the project.

Warrant that upon notification by the Government, any defects in material, workmanship, and door operation are immediately correct within the same time period covered by the guarantee, at no cost to the Government.

3.3.2 Operation And Maintenance

Submit 6 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

Materials

Devices

Electric Door Operators

Hood

Counterbalancing Mechanism

Painting

Procedures

Manufacture's Brochures

Parts Lists

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, operating procedures, and safety precautions. Provide test data that is legible and of good quality.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE
02/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F883	(2013) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2016) Butts and Hinges
ANSI/BHMA A156.13	(2017) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	(2018) Auxiliary Hardware
ANSI/BHMA A156.18	(2016) Materials and Finishes
ANSI/BHMA A156.21	(2014) Thresholds
ANSI/BHMA A156.22	(2017) Door Gasketing and Edge Seal Systems
ANSI/BHMA A156.26	(2012) Continuous Hinges
ANSI/BHMA A156.3	(2014) Exit Devices
ANSI/BHMA A156.36	(2010) Auxiliary Locks
ANSI/BHMA A156.4	(2013) Door Controls - Closers
ANSI/BHMA A156.5	(2014) Cylinder and Input Devices for Locks
ANSI/BHMA A156.6	(2015) Architectural Door Trim
ANSI/BHMA A156.7	(2016) Template Hinge Dimensions
ANSI/BHMA A156.8	(2015) Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2018; TIA 18-1; TIA 18-2; TIA 18-3) Life Safety Code

NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code
NFPA 72	(2019; TIA 19-1; ERTA 2019) National Fire Alarm and Signaling Code
NFPA 80	(2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(updated continuously online) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Manufacturer's Detail Drawings; G M

Verification of Existing Conditions; G M

Hardware Schedule; G M

Keying System; G R

SD-03 Product Data

Hardware Items

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G R

SD-11 Closeout Submittals

Key Bitting; G R

1.3 SHOP DRAWINGS

Submit manufacturer's detail drawings indicating all hardware assembly components and interface with adjacent construction. Indicate power components and wiring coordination for electrified hardware. Base shop drawings on verified field measurements and include verification of existing conditions.

1.4 PRODUCT DATA

Indicate fire-ratings at applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

1.5 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publi-cation Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire-rated and listed)	BHMA Finish Desig-nation

In addition, submit hardware schedule data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6 KEY BITTING CHART REQUIREMENTS

1.6.1 Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (e.g. AA1 and AA2).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.7 QUALITY ASSURANCE

1.7.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.7.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware Subcontractor, using Activity and Base Locksmith must meet to discuss and coordinate key requirements for the facility.

1.8 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown on hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware applied to metal doors must be manufactured using a template. Provide templates to door and frame manufacturers in accordance with ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE. Provide Underwriters Laboratories, Inc. labels for such hardware in accordance with UL Bld Mat Dir or equivalent labels in accordance with another testing laboratory approved in writing by the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark is visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Coordinate electrified door hardware components with corresponding components specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.1 Hinges

Provide in accordance with ANSI/BHMA A156.1. Provide hinges that are 114 by 114 mm unless otherwise indicated. Construct loose pin hinges for interior doors and reverse-bevel exterior doors so that pins are non-removable when door is closed. Provide cpncealed bearing hinges with lifetime warranty.

2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26. Provide manufacturer's lifetime warranty.

2.3.3 Locks and Latches

2.3.3.1 Mortise Locks and Latches

Provide in accordance with ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Cut escutcheons to fit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Provide forged escutcheon with protected cylinder design. Provide manufacturer's lifetime warranty.

2.3.3.2 Auxiliary Locks

Provide in accordance with ANSI/BHMA A156.36, Grade 1.

2.3.4 Exit Devices

Provide in accordance with ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms. Touchpad shall be stainless steel "T" style with ends that are ramped in direction of egress to prevent hooking of carts, equipment and ruck sacks. Endcaps to be ramped and attached with truss style support bracket. Provide 5 year warranty.

2.3.5 Cylinders and Cores

Provide cylinders and cores with seven pin tumblers. All cylinders to have interchangeable small format cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.6 Push Button Mechanisms

Provide in accordance with ANSI/BHMA A156.5, Grade 1. Provide as specified in Hardware Sets.

2.3.7 Electrified Hardware

Comply with the requirements of NFPA 70 for wiring of electrified hardware.

2.3.8 Keying System

Provide a great or grand master keying system as an extension of the existing keying system. Existing locks were manufactured by Best Locks and have interchangeable cores. Provide construction interchangeable cores.

2.3.9 Lock Trim

Provide cast, forged construction and commercial plain design for lock trim.

2.3.9.1 Lever Handles

Provide lever handles as indicated in the Hardware Schedule. Provide in

accordance with ANSI/BHMA A156.3 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 13 mm of the door face. Lever design shall match lockset lever design. Cylinders shall be recessed into face of forged escutcheon for protection.

2.3.10 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master. Furnish 2 great grand master keys, 2 construction master keys, and 2 control keys for removable cores. Stamp each key with appropriate key control symbol and "U.S. property - do not duplicate." Do not place room number on keys.

2.3.11 Door Bolts

Provide in accordance with ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except at doors having metal thresholds. Provide automatic latching flush bolts in accordance with ANSI/BHMA A156.3, Type 25.

2.3.12 Closers

Provide in accordance with ANSI/BHMA A156.4, Series C72000, Grade 1, with PT 4C and 1-1/2-inch piston bore. Provide with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with manufacturer's printed recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's lifetime warranty.

2.3.13 Overhead Holders

Provide in accordance with ANSI/BHMA A156.8.

2.3.14 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

2.3.14.1 Sizes of Kick Plates

50 mm less than door width for single doors; 25 mm less than door width for pairs of doors. Provide 200 mm kick plates for flush doors.

2.3.15 Door Stops and Silencers

Provide in accordance with ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.16 Padlocks

Provide in accordance with ASTM F883.

2.3.17 Thresholds

Provide in accordance with ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out,

unless specified otherwise.

2.3.18 Weatherstripping Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph HARDWARE SCHEDULE. Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weatherstripped doors not to exceed 2.19 by 10-5 cms per minute of air per square meter of door area when tested in accordance with ASTM E283. Provide weatherstripping with one of the following:

2.3.18.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.

2.3.19 Rain Drips

Provide in accordance with ANSI/BHMA A156.22. Provide extruded aluminum rain drips, not less than 2.03 mm thick, clear anodized finish. Provide the manufacturer's full range of color choices to the Contracting Officer for color selection. Provide rain drips with a 102 mm overlap on each side of each exterior door that is not protected by an awning, roof, eave or other horizontal projection. Set drips in sealant and fasten with stainless steel screws.

2.3.19.1 Door Rain Drips

Approximately 38 mm high by 16 mm projection. Align bottom with bottom edge of door.

2.3.20 Auxiliary Hardware (Other than locks)

Provide in accordance with ANSI/BHMA A156.16, Grade 1.

2.3.21 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, as required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of type, quality, size, and quantity appropriate to the specific application. Fastener finish to match hardware. Provide stainless steel or nonferrous metal fasteners in locations exposed to weather. Verify metals in contact with one another are compatible and will avoid galvanic corrosion when exposed to weather.

2.5 FINISHES

Provide in accordance with ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

PART 3 EXECUTION

3.1 INSTALLATION

Provide hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weatherstripping Installation

Provide full contact, weathertight seals that allow operation of doors without binding the weatherstripping.

3.1.1.1 Stop Applied Weatherstripping

Fasten in place with color matched sheet metal screws not more than 225 mm on center after doors and frames have been finish painted.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves. For aluminum thresholds placed on top of concrete surfaces, coat the underside surfaces that are in contact with the concrete with fluid applied waterproofing as a separation measure prior to placement.

3.2 FIRE DOORS AND EXIT DOORS

Provide hardware in accordance with NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, and NFPA 252 for fire tests of door assemblies. .

3.3 HARDWARE LOCATIONS

Provide in accordance with SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Provide complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days

before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

See EXHIBIT A - HARDWARE SETS.

-- End of Section --

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EXHIBIT A – HARDWARE SETS

SET #1

Doors: 106

3	Hinges	CB1960R 4 1/2 x 4 1/2	630	ST
1	Privacy Set	45H-0L14N	630	BE
1	Wall Bumper	1270CVSV	626	TR
3	Door Silencers	1229A	GREY	TR

SET #2

Doors: 103

3	Hinges	CB1960R 4 1/2 x 4 1/2	630	ST
1	Lockset	45H-7D14N PATD	630	BE
1	Door Closer	QDC113 DA	689	ST
1	Gasketing	2525 C		NA

SET #3

Doors: 102B

3	Hinges	CB1960R 4 1/2 x 4 1/2	630	ST
1	Exit Device	FL 2108 X 4908D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Door Closer	QDC113	689	ST
1	Gasketing	2525 C		NA

SET #4 - Overhead

Doors: 101C, 102A, 107, 108

1	Padlock	41B-722T PATD M1	606	BE

SET #5

Doors: 101B, 101D, 104

1	Continuous Hinge	662HD	628	ST
1	Exit Device	2103 CD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Thumb-turn Cylinder	AS REQUIRED	626	BE
1	Flush Pull	1111C	630	TR
1	Door Closer	QDC114 DA	689	ST
1	Kick Plate	K0050 8"	630	TR
1	Door Sweep	C627 A		NA
1	Gasketing	5050C		NA
1	Threshold	950 S	628	NA

SET #6

Doors: 105

2	Continuous Hinge	662HD	630	ST
2	Flush Bolt	3916	626	TR
1	Dustproof Strike	3911	626	TR

1	Deadlock	45H-7RD PATD	626	BE
2	Flush Pull	1111C	630	TR
2	Door Closer	QDC114	689	ST
2	Door Sweep	C627 A		NA
1	Gasketing	5050C		NA
1	Astragal	158 SA		NA
1	Threshold	950 S	628	NA

SECTION 08 91 00

METAL WALL LOUVERS
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-L	(2015) Laboratory Methods of Testing Louvers for Rating
AMCA 511	(2010) Certified Ratings Program for Air Control Devices

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 611	(2014) Voluntary Specification for Anodized Architectural Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall louvers; G M

SD-03 Product Data

Metal Wall Louvers

SD-04 Samples

Wall louvers; G R

Door louvers; G R

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.5 COLOR SAMPLES

Colors of finishes for wall louvers and door louvers shall closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Sheet

ASTM B209M, alloy 3003 or 5005 with temper as required for forming.

2.1.2 Extruded Aluminum

ASTM B221M, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather Wind driven rain resistant type, with bird screens and made to withstand a wind load of not less than 1.44 kilopascals. Wall louvers must bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511. The rating must show a water penetration of 0.06 kilograms or less per square meter of free area at a free velocity of 244 meters per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 2 mm.

2.2.2 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions for all louvers more than 1500 mm in width at not more than 1500 mm on centers. Provide mullions covers on both faces of joints between louvers.

2.2.3 Screens and Frames

For aluminum louvers, provide 12.5 mm square mesh, 1.8 or 1.5 mm aluminum or 6 mm square mesh, 1.5 mm aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Exposed aluminum surfaces shall be factory finished with an anodic coating. Color shall be as indicated on drawings.

2.4.1.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF45 and AAMA 611. Finish shall be:

a. Architectural Class I (0.0175 mm or thicker), designation A44, electrolytically deposited color anodized.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

-- End of Section --

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SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2010; R 2015) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C645	(2014; E 2015) Nonstructural Steel Framing Members
ASTM C754	(2018) Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C841	(2003; R 2013) Installation of Interior Lathing and Furring
ASTM C847	(2014a) Standard Specification for Metal Lath

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2013; with Change 4, 2018) Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Support Systems; G M

Submit for the erection of metal framing, furring, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

SD-03 Product Data

Metal Support Systems

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations permitting easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, Z180; aluminum coating ASTM A463/A463M, T1-75; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per UFC 3-301-01, "Structural Engineering".

Provide metal support systems containing a minimum of 20 percent recycled content. Provide data identifying percentage of recycled content for metal support systems.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, and ASTM C847.

2.1.2 Materials for Attachment of Gypsum Wallboard

2.1.2.1 Suspended and Furred Ceiling Systems

ASTM C645.

2.1.2.2 Furring

ASTM C645, but not thinner than 1.08 mm thickness.

2.1.2.3 Furring Structural Steel Columns

ASTM C645. Steel (furring) clips and support angles listed in UL Fire Resistance may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Lath

3.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, except as indicated otherwise.

3.1.2 Systems for Attachment of Gypsum Wallboard

3.1.2.1 Suspended and Furred Ceiling Systems

ASTM C754, except provide framing members 400 mm o.c. unless indicated otherwise.

3.1.2.2 Furring

ASTM C754, except as indicated otherwise.

3.1.2.3 Furring Structural Steel Columns

Install studs or galvanized steel clips and support angles for erection of gypsum wallboard around structural steel columns in accordance with the UL Fire Resistance, design number(s) of the fire resistance rating indicated on drawings.

3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;

b. Plates and runners: 5 mm in 1.9 meters from a straight line;

c. Face of framing members: 5 mm in 1.9 meters from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;

b. Plates and runners: 5 mm in 3.8 meters from a straight line;

c. Face of framing members: 5 mm in 3.8 meters from a true plane.

-- End of Section --

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SECTION 09 29 00

GYPSUM BOARD
08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1002	(2018) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C1047	(2014a) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1396/C1396M	(2017) Standard Specification for Gypsum Board
ASTM C1629/C1629M	(2018a) Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
ASTM C475/C475M	(2017) Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C840	(2018b) Standard Specification for Application and Finishing of Gypsum Board
ASTM C954	(2018) Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D2394	(2017) Standard Test Methods for Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D5420	(2016) Standard Test Method for Impact

	Resistance of Flat, Rigid Plastic Specimen by Means of a Strike Impacted by a Falling Weight (Gardner Impact)
ASTM E695	(2003; R 2015; E 2015) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Water-Resistant Gypsum Backing Board

Abuse Resistant Gypsum Board

Accessories

Gypsum Board

VOC Content of Joint Compound

SD-07 Certificates

Asbestos Free Materials

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

Indoor Air Quality

SD-08 Manufacturer's Instructions

Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer Maintenance Instructions; G R

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.3.1.1 Ceiling and Wall Systems

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.3.1.2 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.4.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store gypsum wallboard with

materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives. Do not use materials that have visible moisture or biological growth.

1.4.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

1.6 SCHEDULING

Commence application only after the area scheduled for gypsum board work is completely weathertight. The heating, ventilating, and air-conditioning systems must be complete and in operation prior to application of the gypsum board. If the mechanical system cannot be activated before gypsum board is begun, the gypsum board work may proceed in accordance with an approved plan to maintain the environmental conditions specified below. Apply gypsum board prior to the installation of finish flooring and acoustic ceiling.

1.7 ENVIRONMENTAL REQUIREMENTS

Do not expose the gypsum board to excessive sunlight prior to gypsum board application. Maintain a continuous uniform temperature of not less than 10 degrees C and not more than 27 degrees C for at least one week prior to the application of gypsum board work, while the gypsum board application is being done, and for at least one week after the gypsum board is set. Shield air supply and distribution devices to prevent any uneven flow of air across the plastered surfaces. Provide ventilation to exhaust moist air to the outside during gypsum board application, set, and until gypsum board jointing is dry. In glazed areas, keep windows open top and bottom or side to side 75 to 100 mm. Reduce openings in cold weather to prevent freezing of joint compound when applied. For enclosed areas lacking natural ventilation, provide temporary mechanical means for ventilation. In unglazed areas subjected to hot, dry winds or temperature differentials from day to night of 10 degrees C or more, screen openings with cheesecloth or similar materials. Avoid rapid drying. During periods of low indoor humidity, provide minimum air circulation following gypsum boarding and until gypsum board jointing complete and is dry.

1.8 FIRE RESISTIVE CONSTRUCTION

Comply with specified fire-rated assemblies for design numbers indicated per UL Fire Resistance or FM APP GUIDE.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free

materials only. Submit Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

2.1.1 Gypsum Board

2.1.1.1 Regular

1200 mm wide, 15.9 mm thick, tapered edges.

2.1.2 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

2.1.2.1 Regular

1200 mm wide, 15.9 mm thick, tapered edges.

2.1.3 Abuse Resistant Gypsum Board

1200 mm wide, 15.9 mm thick, tapered edges.
Reinforced gypsum panel with imbedded fiber mesh or lexan backing tested in accordance with the following tests. Hard body impact test must attain a Level 2 performance in accordance with ASTM C1629/C1629M. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Abuse resistant gypsum board, when tested in accordance with ASTM E84, have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2.1.3.1 Soft Body Impact Test

ASTM E695 or ASTM D2394 for impact penetration and deformation. ASTM E695 using a 27.2 kg leather bag filled with steel pellets, resisting no less than 407 N-m cumulative impact energy before failure or ASTM D2394 using 139.7 mm hemispherical projectile resisting no less than 357 N-m before failure. Provide test specimen stud spacing a minimum 406 mm on center.

2.1.3.2 Hard Body Impact Test

Comply with hard body impact test in accordance with ASTM C1629/C1629M Classification Level 2.

2.1.3.3 Surface Abrasion Test

Comply with test surface abrasion test in accordance with ASTM C1629/C1629M.

2.1.3.4 Indentation Test

ASTM D5420 or ASTM D1037 for indentation resistance. ASTM D5420 using a .907 kg weight with a 16 mm hemispherical impacting head dropped once 915 mm creating not more than 3.5 mm indentation or ASTM D1037 using no less than 213 kg weight applied to the 11.13 mm diameter ball to create not more than a 0.5 mm indentation depth.

2.1.4 Joint Treatment Materials

ASTM C475/C475M. Product must be low emitting VOC types with VOC limits not exceeding 50 g/L. Provide data identifying VOC content of joint compound. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds

must be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.4.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.4.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.4.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.4.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.4.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.5 Fasteners

2.1.5.1 Screws

ASTM C1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.84 mm thick. ASTM C954 steel drill screws for fastening gypsum board to steel framing members 0.84 to 2.84 mm thick. Provide cementitious backer unit screws with a polymer coating.

2.1.5.2 Staples

1.5 mm thick flattened galvanized wire staples with 11.1 mm wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

Length of Legs	Thickness of Gypsum Board
29 mm	12 mm
32 mm	15 mm

2.1.6 Adhesives

Provide certification or validation of indoor air quality for non-aerosol adhesives applied on the interior of the building (inside of the weatherproofing system). Provide certification or validation of indoor air quality for aerosol adhesives used on the interior of the building (inside of the weatherproofing system).

2.1.6.1 Adhesive for Fastening Gypsum Board to Metal Framing

Not permitted.

2.1.7 Accessories

ASTM C1047. Fabricate from corrosion protected steel designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges must be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.8 Asphalt Impregnated Building Felt

Provide a 6.7 kg asphalt moisture barrier over glass mat covered or reinforced gypsum sheathing. Conforming to ASTM D226/D226M Type 1 (No. 15) for asphalt impregnated building felt.

2.1.9 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 Building Construction Materials

Do not install building construction materials that show visual evidence of biological growth.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.2 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

3.3 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C1396/C1396M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 4 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use self-adhering fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.3.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.4 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.4.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Do not place construction and materials behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.

3.5 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

-- End of Section --

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SECTION 09 65 30

RESILIENT WALL BASE AND ACCESSORIES
01/20

PART 1 GENERAL

1.1 SECTION INCLUDES

Resilient base.

1.2 RELATED SECTIONS

Section 09 67 23 - Epoxy concrete flooring to receive base.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E648	Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
ASTM F1861	(2016) Standard Specification for Resilient Wall Base

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit under provisions of Section 01 30 00.

Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

a. Fire-Test Response Characteristics: Critical Radiant Flux Classification: Class I, not less than 0.45 W in accordance with ASTM E648.

b. Manufacturer Qualifications: Provide resilient wall base materials manufactured in the United States of America by a firm with a minimum of 10 years' experience with resilient vinyl materials of type equivalent to those specified.

c. Provide resilient wall base, adhesives and accessories preparation products from one manufacturer to ensure color matching and compatibility.

1.6 DELIVERY, STORAGE, AND HANDLING

Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 degrees F or more than 80 degrees F.

1.7 PROJECT CONDITIONS

a. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F or more than 95 degrees F, in spaces to receive resilient products during 48 hours before installation, during installation and 48 hours after installation.

b. Until Substantial Completion, maintain relative humidity between 40 percent and 65 percent during installation.

c. Install resilient products after other finishing operations, including painting, have been completed.

d. Avoid conditions in which dew point causes condensation on the installation surface.

PART 2 PRODUCTS

2.1 MATERIALS

a. Resilient Base:

(1) ASTM F1861; Type TV; Group 2; style A & B; Cove (base with no toe); 3.2mm thick; height and color as indicated on the Drawings.

(2) Length: Coils in manufacturer's standard length.

2.2 INSTALLATION MATERIALS

a. Adhesives: Adhesives should be selected based on the site conditions and use of the space being installed.

PART 3 EXECUTION

3.1 EXAMINATION

a. Verify that finishes of substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

b. Proceed with installation only after unsatisfactory conditions have been corrected.

c. Beginning of installation means acceptance of existing substrate and site conditions.

3.2 PREPARATION

a. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

b. Fill cracks, holes, and depressions in substrates with trowelable

leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

c. Do not install resilient products until they are same temperature as space where they are to be installed. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

3.3 RESILIENT BASE INSTALLATION

a. Comply with manufacturer's written instructions for installing resilient base.

b. Apply resilient base to walls, columns, pilasters, and other permanent fixtures in room and areas where base is required.

c. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

d. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

e. Do not stretch resilient base during installation.

f. Preformed Corners: Install preformed corners before installing straight pieces.

g. Job-Formed Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT MOLDING ACCESSORY INSTALLATION

a. Comply with manufacturer's written instructions for installing resilient accessories.

b. Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet that would otherwise be exposed.

3.5 APPLICATION

a. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

b. Remove adhesive and other blemishes from exposed surfaces.

c. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

-- End of Section --

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SECTION 09 67 23

RESINOUS FLOORING
01/20

PART 1 GENERAL

1.1 SECTION INCLUDES

A high-performance coating system that consists of a two-component epoxy primer and a three-component moisture-cure urethane with superior abrasion resistance. Low VOC (86 g/L). (Complies with SCAQMD VOC regulations.)

1.2 RELATED REQUIREMENTS

Section 09 65 30 - Resilient Wall Base

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D2369	(2010; R 2015; E 2015) Volatile Content of Coatings
ASTM D2370	(1998; R 2010) Tensile Properties of Organic Coatings
ASTM D3960	(2005; R 2013) Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4060	(2014) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM F1869	(2016) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2170	(2019) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

1.4 PREAPPLICATION MEETINGS

a. Convene preapplication meeting 2 weeks before start of application of flooring system.

b. Require attendance of parties directly affecting work of this Section, including Contractor, Architect, applicator, and manufacturer's representative.

c. Review materials, moisture testing of concrete, protection of in-place conditions, surface preparation, application, protection, and coordination with other work.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G M/R

Applicator's Qualifications; G M/R

SD-03 Product Data

Resinous Flooring System

SD-04 Samples

Resinous Flooring System; G R

Flooring Surface; G R

SD-07 Certificates

Manufacturer's Certification

SD-08 Manufacturer's Instructions

Care and maintenance Instructions

SD-11 Closeout Submittals

Warranty Documentation; G M/R

1.6 DELIVERY, STORAGE, AND HANDLING

a. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer.

b. Storage and Handling Requirements:

(1) Store and handle materials in accordance with manufacturer's instructions.

(2) Keep materials in manufacturer's original, unopened containers and packaging until application.

(3) Store materials in clean, dry area indoors between 18 and 32 degrees C.

(4) Store materials out of direct sunlight.

(5) Keep materials from freezing.

(6) Protect materials during storage, handling, and application to

prevent contamination or damage.

1.7 AMBIENT CONDITIONS

a. Apply flooring system under the following ambient conditions:

(1) Ambient, Concrete Floor, and Material Temperatures: Between 18 and 32 degrees C.

(2) Relative Humidity: Maximum 80 percent.

(3) Dew Point: Floor temperature more than 5 degrees over dew point.

b. Do not apply flooring system under ambient conditions outside manufacturer's limits.

PART 2 PRODUCTS

2.1 RESINOUS FLOORING SYSTEM

Description: A high performance coating system that consists of a two-component epoxy primer and a three-component moisture-cure urethane with superior abrasion resistance. Low VOC (86 g/L). (Complies with SCAQMD VOC regulations.)

a. Primer: A two component epoxy

(1) Percent Solids, ASTM D2369

(a) Part A - 99.65 percent

(b) Part B - 100 percent

(2) Volatile Organic Compound (VOC), ASTM D3960

(a) 9 g/L

b. Coating: A three component moisture-cure urethane.

(1) Volatile Organic Compound (VOC), ASTM D3960

(a) 86 g/L

(2) Abrasion Resistance, ASTM D4060

(a) 18 mg loss @ 1000 revolutions

93) Tensile Strength, ASTM D2370

(a) 43.092 MPa

(4) Percent Elongation, ASTM D2370

(a) 6 percent (resin only)

(5) Percent Solids (by wt.)

(a) Part A - 99.35 percent

(b) Part B - 59.23 percent

(c) Part C - 100 percent

(d) Mixed - 94 percent

c. Submit manufacturer's product data, including surface preparation and application instructions.

d. Submit manufacturer's samples of flooring surface showing texture and sheen.

e. Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

f. Care and maintenance Instructions: Submit manufacturer's care and maintenance instructions, including cleaning instructions.

2.2 QUALIFICATIONS

2.2.1 Manufacturer's Qualifications

Submit manufacturer's list of successfully completed resinous flooring system projects, including project name and location, name of architect, and type and quantity of flooring systems furnished.

Applicator's Qualifications

Submit applicator's list of successfully completed resinous flooring system projects, including project name and location, name of architect, and type and quantity of flooring systems applied.

2.3 WARRANTY

Submit manufacturer's standard Warranty Documentation.

PART 3 EXECUTION

3.1 EXAMINATION

a. Examine concrete surface to receive floor coating system. Do not begin surface preparation or application until unacceptable conditions have been corrected.

b. Allow concrete substrate to cure a minimum of 30 days.

c. CHECK THE TEMPERATURE AND HUMIDITY: floor temperature and materials should be between 18 degrees C and 32 degrees C. Humidity must be less than 80 percent. DO NOT coat floor unless temperature is more than five degrees over the dew point.

d. Moisture Testing of Concrete: Perform at least one of the following two tests to determine moisture in concrete.

(1) Calcium Chloride Test:

(a) Measure moisture vapor emission rate of concrete in accordance with ASTM F1869.

(b) Application of flooring system can start only if test results are below 1.5 kg/92.9 m^2 over a 24-hour period.

(c) If test results are above limits, notify Architect and flooring system manufacturer.

(2) In-Situ Probe test:

(a) Measure relative humidity in concrete in accordance with ASTM F2170.

(b) Application of flooring system can start only if test results are below 75 percent relative internal concrete humidity.

(c) If test results are above limits, notify Architect and flooring system manufacturer.

e. Do not begin surface preparation or application until unacceptable conditions are corrected.

3.2 PREPARATION

a. Protection of In-Place Conditions: Protect adjacent surfaces and adjoining walls from contact with flooring system materials.

b. Surface Preparation:

(1) Prepare concrete surface in accordance with manufacturer's instructions.

(2) Remove dirt, dust, debris, oil, grease, curing agents, bond breakers, paint, coatings, sealers, silicones, and other surface contaminants which could adversely affect application of flooring system.

(3) Patch depressions, divots, and cracks in concrete in accordance with manufacturer's instructions.

(4) Mechanically remove loose, delaminated, and damaged concrete and repair in accordance with manufacturer's instructions.

(5) Joints: Fill joints in accordance with manufacturer's instructions.

(6) Remove coating or membrane from existing concrete with one of the following methods:

(a) Shotblast

(b) Diamond Grind

(c) Scarify

(7) Vacuum or Sweep concrete surface

3.3 APPLICATION

a. Apply floor coating system in accordance with manufacturer's instructions.

(1) Assemble squeegees and rollers; clean rollers to remove residual lint.

(2) Primer Coat

(a) Mix Components together

(b) Mix only enough material which can be applied within 20 minutes.

(c) Apply primer at the rate of 231-535 ft/gal.

(d) Allow primer to cure 8 hours at 75 degrees and 50 percent relative humidity.

b. Coating: Satin Urethane Topcoat

(1) Note: Epoxy must be thoroughly sanded and cleaned prior to application.

(2) Open and mix only enough material which can be applied in a 2 hour period.

(3) Apply Topcoat 100 at the rate of 500 ft/gal.

3.4 PROTECTION

a. Allow flooring system to dry in accordance with manufacturer's instructions before opening to traffic.

b. Allow flooring system to dry a minimum of 1 week before cleaning by mechanical means.

c. Protect completed flooring system from damage during construction.

d. Close job site to traffic for a period of 24 hours after coating application at 23 degrees C and 50 percent relative humidity.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100	(2015; Suppl 2002-2016) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASME INTERNATIONAL (ASME)

ASME A13.1	(2015) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4444	(2013; R 2018) Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D6386	(2016) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F1869	(2016) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 101	(2012) Primer, Epoxy, Anti-Corrosive, for Metal
MPI 107	(2012) Primer, Rust-Inhibitive, Water Based
MPI 108	(2012) Epoxy, High Build, Low Gloss
MPI 11	(2012) Latex, Exterior Semi-Gloss, MPI Gloss Level 5

MPI 113	(2012) Elastomeric, Pigmented, Exterior, Water Based, Flat
MPI 134	(2012) Primer, Galvanized, Water Based
MPI 141	(2012) Latex, Interior, High Performance Architectural, Semi-Gloss (MPI Gloss Level 5)
MPI 163	(2012) Light Industrial Coating, Exterior, Water Based, Semi-Gloss (MPI Gloss Level 5)
MPI 23	(2012) Primer, Metal, Surface Tolerant
MPI 26	(2012) Primer, Galvanized Metal, Cementitious
MPI 4	(2012) Interior/Exterior Latex Block Filler
MPI 42	(2012) Textured Coating, Latex, Flat
MPI 47	(2012) Alkyd, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 50	(2012) Primer Sealer, Latex, Interior
MPI 54	(2012) Latex, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 77	(2012) Epoxy, Gloss
MPI 79	(2012) Primer, Alkyd, Anti-Corrosive for Metal
MPI 94	(2012) Alkyd, Exterior, Semi-Gloss (MPI Gloss Level 5)

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning
SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC QP 1	(2012; E 2012) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning

SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; E 2000; E 2004) Hand Tool Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders
UFC 1-200-01	(2019) DoD Building Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. Provide all coats on a particular substrate from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

Piping Identification; G M

SD-03 Product Data

Coating

SD-04 Samples

Color; G R

Textured Wall Coating System; G R

Sample Textured Wall Coating System Mock-Up; G R

SD-07 Certificates

Applicator's Qualifications

Qualification Testing laboratory for coatings

Indoor Air Quality for Paints and Primers

Indoor Air Quality for Consolidated Latex Paints

SD-08 Manufacturer's Instructions

Mixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Coatings; G R

1.3 CERTIFICATES

1.3.1 Indoor Air Quality

Submit required indoor air quality certifications in one submittal package.

1.3.1.1 Paints and Coatings

Provide paint and coating products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification documentation from certification body.

1.4 APPLICATOR'S QUALIFICATIONS

1.4.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of

three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.4.2 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application must be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and must remain certified while accomplishing any surface preparation or coating application. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

1.5 QUALITY ASSURANCE

1.5.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURES. Test each chosen product as specified in the paragraph TESTING PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing at no cost to the Government.

1.5.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor will provide one liter samples of the selected paint materials. Take samples in the presence of the Contracting Officer, and label, and identify each sample. Provide labels in accordance with the paragraph

PACKAGING, LABELING, AND STORAGE of this specification.

1.5.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. Include the backup data and summary of the test results within the qualification testing lab report. Provide a summary listing of all the reference specification requirements and the result of each test. Clearly indicate in the summary whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Provide samples of wall coating systems minimum 125 by 175 mm and of sufficient size to show pattern repeat and texture.

1.5.3 Sample Textured Wall Coating System Mock-Up

After coating samples are approved, and prior to starting installation, provide a minimum 2.43 m by 2.43 m mock-up for each substrate and for each color and type of textured wall coating, using the actual substrate materials. Use the approved mock-up samples as a standard of workmanship for installation within the facility. Submit at least 48 hour advance written notice to the Contracting Officer's Representative prior to mock-up installation.

1.6 REGULATORY REQUIREMENTS

1.6.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.6.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.4 Asbestos Content

Provide asbestos-free materials.

1.6.5 Mercury Content

Provide materials free of mercury or mercury compounds.

1.6.6 Silica

Provide abrasive blast media containing no free crystalline silica.

1.6.7 Human Carcinogens

Provide materials that do not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.7 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 20 liters. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 4 to 35 degrees C. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to adsorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.8 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Comply with applicable Host Nation regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. Include in the Activity Hazard Analysis the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.8.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100, threshold limit values.

1.9 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 3 degrees C above dew point;

b. Below 10 degrees C or over 35 degrees C, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Do not, under any circumstances, violate the manufacturer's application recommendations.

1.9.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 13 degrees C and 29 degrees C and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.10 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs.

1.11 COLOR SELECTION

Provide colors of finish coats as indicated on drawings. Allow Contracting Officer to select colors not indicated or specified. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Provide color, texture, and pattern of wall coating systems as indicated on drawings.

1.12 LOCATION AND SURFACE TYPE TO BE PAINTED

1.12.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.12.1.1 Exterior Painting

Includes new surfaces and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

All paints and primers are to be corrosive resistant in compliance with Master Painters Institute's performance standards, to protect metal surfaces against severe corrosive environment.

Per UFC 1-200-01, any galvanized steel shall be coated with an industrial coating (paint).

1.12.1.2 Interior Painting

Includes new surfaces and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.12.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Hardware, fittings, and other factory finished items.

1.12.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

1.12.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm, spaces above suspended ceilings, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. In lieu of red enamel finish coat, provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals.

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm. Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals throughout the piping systems.

1.12.4 Definitions and Abbreviations

1.12.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.12.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing must be accomplished by an MPI testing lab.

1.12.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on

various substrates (such as metals, plastics, wood, paper, leather, cloth). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.12.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.12.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.12.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.12.4.7 EXT

MPI short term designation for an exterior coating system.

1.12.4.8 INT

MPI short term designation for an interior coating system.

1.12.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.12.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.12.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.12.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degrees	Units at 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.12.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.12.4.14 Paint

See Coating definition.

1.12.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.12.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit product data sheets for specified coatings and solvents. Provide preprinted cleaning and maintenance instructions for all coating systems.

Provide certification of Indoor Air Quality for paints and primers.

Provide certification of Indoor Air Quality for consolidated latex paints.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect hardware, hardware accessories, machined surfaces, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, reinstall removed items by workmen skilled in the trades. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, or SSPC SP 6/NACE No.3. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Protect shop-coated ferrous surfaces from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3/SSPC SP 12/NACE No.5 WJ-3.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. Use as a visual reference, photographs in SSPC VIS 3 for the appearance of cleaned surfaces.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. Use as a visual reference, photographs in SSPC VIS 1 for the appearance of cleaned surfaces.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. Completely remove coating by brush-off abrasive blast if the galvanized metal has been passivated or stabilized. Do not "passivate" or "stabilize" new galvanized steel to be coated. If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble

contaminants.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Allow concrete and masonry surfaces to cure at least 30 days before painting, and concrete slab on grade to cure at least 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Grease, and Oil: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, and 6.4 liters of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 0.4 square meter of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 1.36 kgs of moisture per 92.9 square meters in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

a. Surface Cleaning: Verify that plaster and stucco surfaces are free from loose matter and that gypsum board is dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Clean wood surfaces of foreign matter.

   Surface Cleaning: Verify that surfaces are free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.

b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.

c. Do not exceed 12 percent moisture content of the wood as measured by a moisture meter in accordance with ASTM D4444, Method A, unless otherwise authorized.

d. Prime or touch up wood surfaces adjacent to surfaces to receive water-thinned paints before applying water-thinned paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

   (1) Knots and Resinous Wood and Fire, Smoke, Water, and Color Marker Stained Existing Coated Surface: Prior to application of coating, cover knots and stains with two or more coats of 1.3-kg-cut shellac varnish, plasticized with 0.14 liters of castor oil per liter. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

   (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

   (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

g. Prime Coat For New Exterior Surfaces: Prime coat before wood becomes dirty, warped.

3.6 APPLICATION

3.6.1 Coating Application

Comply with applicable Host Nation laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint must show no signs of deterioration. Maintain uniform suspension of pigments during application.

Unless otherwise specified or recommended by the paint manufacturer, paint

may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Use rollers for applying paints and enamels of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Only apply paints, except water-thinned types to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Pay special attention to ensure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Apply each coat of paint so that dry film is of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Completely hide all blemishes.

Touch up damaged coatings before applying subsequent coats. Broom clean and clear dust from interior areas before and during the application of coating material.

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 0.025 mm. Unfinished spaces include attic spaces, spaces above suspended ceilings, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Cover each preceding coat or surface completely by ensuring visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. Verify that the written permission includes quantities and types of thinners to use.

When thinning is allowed, thin paints immediately prior to application with not more than 0.125 L of suitable thinner per liter. The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

3.6.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table

Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 0.038 mm each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat. Overcoat these items with the specified ferrous-metal primer prior to application of finish coats.

e. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.9 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101 ASME A13.1. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101 ASME A13.1, stencil approved names or code letters, in letters a minimum of 13 mm high for piping and a minimum of 50 mm high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.10 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.11 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, contact local recyclers to reclaim the materials.

3.12 PAINT TABLES

All DFT's are minimum values.

3.12.1 Exterior Paint Tables

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. New concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. Latex
   New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI EXT 3.1A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 11 MPI 11 MPI 11
   System DFT: 88 microns

   Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.

B. New concrete, textured system; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. Latex Aggregate
   New; MPI EXT 3.1B-G5 (Semigloss) / Existing; MPI REX 3.1B-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 42 MPI 11 MPI 11
   System DFT: Per Manufacturer

   Texture - Medium. Surface preparation and number of coats in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.

C. New concrete, elastomeric System; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. Elastomeric Coating
   New; MPI EXT 3.1F / Existing; MPI REX 3.1F
   Primer: Intermediate: Topcoat:
   Per Manufacturer MPI 113 MPI 113
   System DFT: 400 microns

   Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

   NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 400 microns.

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New concrete masonry on uncoated surface:

1. Latex
   New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2A-G5 (Semigloss)
   Block Filler: Primer: Intermediate: Topcoat:
   MPI 4 N/A MPI 11 MPI 11
   System DFT: 275 microns

B. New concrete masonry, textured system; on uncoated surface:

1. New; MPI EXT 4.2B-G5 (Semigloss) / Existing; MPI REX 4.2B-G5 (Semigloss)

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

Primer:	Intermediate:	Topcoat:
MPI 42	MPI 42	MPI 11

System DFT: Per Manufacturer

Texture - Medium. Surface preparation and number of coats in accordance with manufacturer's instructions.

C. New concrete masonry, elastomeric system; on uncoated surface:

1. Elastomeric Coating
New; MPI EXT 4.2D / Existing; MPI REX 4.2D

Primer:	Intermediate:	Topcoat:
Per Manufacturer	MPI 113	MPI 113

System DFT: 400 microns

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 400 microns.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Alkyd
New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 94	MPI 94

System DFT: 131 microns

B. New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3:

1. Alkyd
New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 94	MPI 94

System DFT: 131 microns

C. New steel blast cleaned to SSPC SP 10/NACE No. 2:

1. Waterborne Light Industrial
MPI EXT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 163

System DFT: 212 microns

EXTERIOR GALVANIZED SURFACES

D. New Galvanized surfaces:

1. MPI EXT 5.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:

EXTERIOR GALVANIZED SURFACES
MPI 26 MPI 11 MPI 11
System DFT: 112 microns

2. MPI EXT 5.3H-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 11 MPI 11
System DFT: 112 microns

3. Epoxy Primer / Waterborne Light Industrial Coating
MPI EXT 5.3K-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 163 MPI 163
System DFT: 125 microns

E. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating
MPI REX 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 N/A MPI 163
System DFT: 112 microns

F. Galvanized surfaces with severely deteriorated coating or rusting:

1. Waterborne Light Industrial Coating
MPI REX 5.3L-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 163
System DFT: 212 microns

3.12.2 Interior Paint Tables

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New Concrete, vertical surfaces, not specified otherwise:

1. Latex
New; MPI INT 3.1A-G5 (Semigloss) / Existing; MPI RIN 3.1A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 54 MPI 54
System DFT: 100 microns

2. High Performance Architectural Latex
New; MPI INT 3.1C-G5 (Semigloss) / Existing; MPI RIN 3.1J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 141 MPI 141
System DFT: 100 microns

B. Concrete ceilings, uncoated:

1. Latex Aggregate
MPI INT 3.1N
Primer: Intermediate: Topcoat:
N/A N/A MPI 42
System DFT: Per Manufacturer

DIVISION 3: INTERIOR CONCRETE PAINT TABLE
Texture - Fine. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions.

C. New concrete floors:

1. Epoxy
New; MPI INT 3.2C-G6 (Gloss) / Existing; MPI RIN 3.2C-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 125 microns

Note: Primer may be reduced for penetration per manufacturer's instructions.

A. New Concrete masonry:

1. High Performance Architectural Latex
MPI INT 4.2D-G2 (Flat)

MPI INT 4.2D-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 141	MPI 141

System DFT: 275 microns

Fill all holes in masonry surface

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports:

1. MPI INT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 141	MPI 141

System DFT: 125 microns

2. MPI INT 5.1E-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 47	MPI 47

System DFT: 131 microns

DIVISION 9: INTERIOR GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New Wallboard not otherwise specified:

1. Latex
New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 100 microns

2. High Performance Architectural Latex - High Traffic Areas
New; MPI INT 9.2B-G5 (Semigloss) / Existing; MPI RIN 9.2B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:

DIVISION 9: INTERIOR GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

MPI 50	MPI 141	MPI 141
System DFT: 100 microns		

-- End of Section --

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SECTION 09 96 00

HIGH-PERFORMANCE COATINGS
11/14

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM SI10	(2016) American National Standard for Use of the International System of Units (SI): The Modern Metric System

MASTER PAINTERS INSTITUTE (MPI)

MPI ASM	(2012) Architectural Painting Specification Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

QPL-TNT-AP-28	(2004) Paint, Aluminum, Heat Resisting (1200 Degrees F)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment List; G M/R

SD-03 Product Data

Heat-Resistant Coatings

Epoxy Coatings

Polyurethane Coatings

Chlorinated-Rubber Coatings

SD-04 Samples

Color Chips; G R

SD-07 Certificates

Heat-Resistant Coatings

Epoxy Coatings

Polyurethane Coatings

Chlorinated-Rubber Coatings

Manufacturer's Printed Instructions

1.3 QUALITY CONTROL

Comply with Master Painters Institute (MPI) Standards indicated and listed in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started.

Submit an equipment list consisting of a list of proposed equipment to be used in performance of construction work.

Submit three color chips 75 millimeter by 100 millimeter or manufacture's pull-down of each finish color and gloss as scheduled.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver special coating materials to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Store special coating materials in tightly closed containers in a covered, well-ventilated area where they are not exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Store solvents, thinners, and equipment cleaners with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 7 degrees C.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Submit manufacturer's catalog data including manufacturer's name and identification. Include detailed data analysis of each special coating material required for the project, with all the coating constituents measured as percentages of the total weight of the coating. Also provide manufacturer's data concerning application, thinning, and average coverage per liter

2.1.1 Heat-Resistant Coatings

2.1.1.1 Category 1, 10 to 204 Degrees C

Provide alkyd resin-based material for surface temperature coatings not exceeding 204 degrees C. Apply a minimum two coats of coating with a dry-film thickness of a minimum 0.1 millimeter.

Apply an epoxy zinc primer as a first coat conforming to MPI ASM, No. 20 with the resin solids and zinc pigment not less than 80 percent of the total weight of the material.

White and color pigmented finish coats are an alkyd resin-based material with the resin solids and pigments not less than 85 percent of the total weight of the material. Ensure pigments are heat-stable materials, formulated to colors as scheduled.

Ensure black-pigmented finish coats are an alkyd resin, carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Provide aluminum pigmented finish coats that are an alkyd resin-based material with resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.1.2 Category 2, 149 to 316 Degrees C

Coatings for surface temperatures not exceeding 316 degrees C are based on modified silicone and silicone-based resins. Apply coatings in not less than two coats with a dry-film thickness of not less than.

Provide a silicone-based resin zinc-pigmented material with the resin solids and zinc pigment for the first coat not less than 80 percent of the total weight of the material.

Apply color pigmented finish coats using silicone-based resin material with the resin solids and pigments not less than 80 percent of the material's total weight. Pigments are heat-stable materials, formulated to colors as scheduled.

Ensure black-pigmented finish coat is a silicone-based resin carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum-pigmented finish coats are a modified, silicone-based-resin material with the resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.1.3 Category 3, 316 to 427 Degrees C

Provide a modified silicone or a silicone-based material of coating for surface temperatures not exceeding 427 degrees C. Apply a minimum two coats with a dry-film thickness of a minimum 0.07 millimeter.

Provide a silicone-based resin, zinc-pigmented material first coat with the resin solids and zinc pigment for the first coat not less than 80 percent of the total weight of the material.

Ensure black-pigmented finish coat is a silicone-based resin, carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum-pigmented finish coat is a a modified, silicone-based-resin material with the resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.1.4 Category 4, 427 to 649 Degrees C

Provide an aluminum-pigmented, silicone-resin-based coating for surface temperatures not exceeding 649 degrees C conforming to QPL-TNT-AP-28, as modified.

Apply a minimum two coats with a minimum 0.05 millimeter dry-film thickness of.

Ensure the coating pigment contains a minimum 28 percent aluminum, based on the total weight of the material. Ensure coating contains a minimum of 22 percent silicone resin and a maximum of 49 percent of volatile thinners and driers based on the total weight of the material.

2.2 MATERIALS

2.2.1 Epoxy Coatings

Conform to MPI ASM, No. 116 for epoxy coatings and epoxy block filler, as modified.

Resins for finish coats are based on a polyamide-cured, epoxy-resin material. Apply finish coats with a dry-film thickness of not less than 0.1 millimeter per coat. Finish color and gloss are as indicated.

2.2.1.1 Concrete Surface Coatings

Apply an epoxy coating system in conformance with MPI ASM, No. 7. Apply an epoxy slip-resistant deck coating system in conformance with MPI ASM, No. 82. Apply a prime coat to fill concrete surface pores with a total dry-film thickness of not less than 0.05 millimeter.

2.2.1.2 Masonry Surfaces Coatings

Apply a block filler to fill surface pores with a total dry-film thickness of not less than 0.2 millimeter.

2.2.1.3 Ferrous and Galvanized Metal Surface Coatings

Coatings on ferrous and galvanized metal surfaces consist of a prime coat and not less than two finish coats. Comply with MPI ASM, No. 101 for an epoxy zinc primer with a metallic-zinc pigment for the substrate to be coated and the end use of the coated surface. Ensure resin solids and zinc pigment are not less than 80 percent of the total weight of the coating material. Apply prime coat with a total dry-film thickness of not less than 0.1 millimeter. Provide an epoxy-based finished coat as specified.

2.2.1.4 Aluminum Surface Coatings

Apply an Epoxy Coating System in conformance with MPI ASM, No. 80 and MPI ASM, No. 77. Apply a prime coat with a total dry-film thickness of not less than 0.1 millimeter.

2.2.2 Polyurethane Coatings

Ensure polyurethane coatings use ASTM SI10 and conform to MPI ASM for each substrate indicated.

Resins for finish coats are based on a two-part, prepolymer, catalytic-cured, polyurethane material. Apply catalytic-cured coatings with a total dry-film thickness of not less than 0.25 millimeter per coat. Indicate finish color and gloss on the schedules.

2.2.2.1 Concrete Surface Coatings

Apply a polyurethane, pigmented coating system in conformance with MPI ASM, No. 72 and MPI ASM, No. 80. Ensure the prime coat fills surface pores with a total dry-film thickness of not less than 0.05 millimeter. Finish coats are polyurethane-based material as specified.

2.2.2.2 Masonry Surface Coatings

Apply a polyurethane, clear, two-component coating system in conformance with MPI ASM, No. 78. Apply block filler to fill surface pores with a total dry-film thickness of not less than 0.2 millimeter. Finish coats are polyurethane-based material as specified.

2.2.2.3 Ferrous and Galvanized Metal Surface Coatings

Apply a polyurethane, pigmented coating system in conformance with MPI ASM, No. 72, MPI ASM, No. 77, and MPI ASM, No. 101. Apply a prime coat with a dry-film thickness of not less than 0.05 millimeter. Finish coats are polyurethane-based material as specified.

2.2.3 Chlorinated-Rubber Coatings

2.2.3.1 Concrete Surface Coatings

Apply a minimum three coats on concrete surfaces. Provide prime coats with a chlorinated-rubber resin material as recommended by the coating manufacturer for the substrate to be coated and the end use of the coated surfaces. Ensure the prime coat fills concrete surface pores with a total film thickness of not less than 0.05 millimeter. Finish coats are chlorinated-rubber-based coatings as specified.

2.2.3.2 Masonry Surface Coatings

Apply a minimum of two finish coats of masonry block filler on masonry surfaces. Block fillers are based on an epoxy-ester resin material as recommended by the coating manufacturer for the substrate and end use of the coated surface. Fill surface pores with block filler at a total film thickness of not less than 0.2 millimeter. Finish coats are chlorinated-rubber-based coatings as specified.

2.2.3.3 Ferrous and Galvanized Metal Surface Coatings

Apply a minimum two coats of high performance architectural latex coating in conformance with MPI ASM, No. 79 on ferrous and galvanized metal surfaces. Apply prime coat with a dry-film thickness of not less than 0.07 millimeter. Finish coats are chlorinated rubber-based coatings as specified.

2.2.3.4 Aluminum Surface Coatings

Apply a minimum three coats of quick drying primer for aluminum surfaces. Ensure prime coats conform to MPI ASM, No. 80 for aluminum coating system.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surface Preparation

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Leave clean building materials and equipment with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by the Contracting Officer, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching with water and placing them in a covered metal container

3.1.2 Cleaning

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Clean application equipment promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

3.1.3 Concrete Surfaces

Conform to MPI ASM for substrates indicated. Remove plates, machined surfaces, and similar items already in place that are not to be coated. Provide surface-applied protection before surface preparation and coating where removal is impractical or impossible. After completing coating operations, reinstall items that were removed.

Clean dirt, oil, grease, and incompatible paints from substrates to ensure bonding. Coordination of shop-applied prime coats with high-performance coatings is critical. Remove incompatible primers. Reprime substrate with compatible primers as required to produce coating systems indicated.

3.1.3.1 Concrete Substrates

Remove release agents, curing compounds, efflorescence, and chalk. Maximum allowable moisture content of concrete is 12 percent. Measure moisture content with an electronic moisture meter.

Clean surfaces with pressurized water. Use pressure range of 10 350 to 27 580 kPa at 150 mm to 300 mm.

Comply with SSPC 7/NACE No.4 (NACE No. 4), "Brush-Off Blast Cleaning" for abrasive cleaning.

3.1.3.2 Clay Masonry Substrates

Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.

Clean surfaces with pressurized water. Use pressure range of 690 to 4140 kPa at 150 to 300 mm.

3.1.3.3 Steel Substrates

Remove rust and loose mill scale. Clean using methods recommended in writing by coating manufacturer. Conform to SSPC 7/NACE No.4 for blast cleaning.

3.1.3.4 Galvanized-Metal Substrates

Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.1.3.5 Aluminum Substrates

Remove surface oxidation.

3.1.3.6 Wood Substrates

Wood substrates that contain small surface knots are prepped by sanding surfaces smooth. Apply a thin coat of knot sealer before applying an interior latex-based wood primer. Prime edges, ends, faces, undersides, and back sides of wood. After priming, fill holes and crevices to the finished surface with putty or plastic wood filler. After finished surface is dry, smooth surface by sanding, for a finished product.

3.1.4 Coating Material Preparation

Mix and prepare coating materials in accordance with the coating manufacturer's printed instructions for applying the particular material and coat. Keep materials which are not in actual use in closed containers.

Coating materials that have been mixed with an automatic shaker are allowed to stand to let air bubbles escape, then given a final hand mixing before application. Stir materials so as to produce a mixture of uniform density. Stir at frequent intervals during application to prevent skinning. Do not stir film which may form on the surface of the material. Remove film and strain, if necessary.

3.1.4.1 Thinning

Thinning is done in accordance with coating manufacturer's printed directions for the particular material and coat.

3.1.4.2 Tinting

Ensure prime and intermediate coats of paint are slightly different tints from the finish coat to facilitate identification of each coat. Tinting is done by the coating manufacturer and clearly identified as to color and coat.

3.2 APPLICATION

Do not perform exterior painting in damp or rainy weather. Interior painting is not allowed until the building is enclosed and has thoroughly dried out. Painting is not allowed below 10 degrees C or above 35 degrees C. Apply paint in accordance with the coating manufacturer's recommendations, and as specified.

Ensure coating application is done by skilled applicators. Apply coatings to clean and properly prepared surfaces. Apply coatings with clean, high-quality application equipment. Allow sufficient time between coats to ensure complete drying and curing. Sand and dust surfaces between coatings, as required, to produce a surface free of visible defects. Lightly sand high gloss coatings and clear finishes between coats to ensure bond of following coats.

Apply coats to the surfaces in an even film. Cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections are not acceptable. Remove defective coating applications and re-coat as directed.

Ensure coating lines such as wainscots are sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

Ensure surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, meet the dry-film thickness not less than specified.

3.2.1 Brush Application

Use clean, proper size brushes for high-quality application of the specified coating materials. Brush out slow-dry coatings. Brush out quick-dry coatings only enough to spread out evenly.

3.2.2 Roller Application

Use clean roller covers of the proper nap length, nap texture, and material for high-quality application of the specified coating materials.

Ensure roller application is equivalent in all respects to the same coats applied by high-quality brush application.

3.2.3 Spray Application

Spray application of coatings is limited to finish coats on metal frame works, siding, decking, wire mesh, and other surfaces where hand work would be inferior. Apply spray coatings as equivalent in all respects to the same coats applied by high quality brush application. Permit each spray coat to cure before the succeeding coat is applied. Do not double back with application equipment, for the purpose of building up film thickness of two coats in one operation.

Cover surfaces adjacent to sprayed areas to prevent damage from overspray, coating rebound, and spray drift.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Test

Government will take dry-film tests on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

3.3.2 Repairing

Remove damaged and unacceptable portions of completed work and replace with new work to match adjacent surfaces at no additional cost to the Government.

-- End of Section --

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SECTION 09 97 13.27

EXTERIOR COATING OF STEEL STRUCTURES
10/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1200	(2010; R 2014) Viscosity by Ford Viscosity Cup
ASTM D1640/D1640M	(2014) Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D3276	(2015; E 2016) Standard Guide for Painting Inspectors (Metal Substrates)
ASTM D3925	(2002; R 2015) Sampling Liquid Paints and Related Pigmented Coatings
ASTM D4285	(1983; R 2012) Indicating Oil or Water in Compressed Air
ASTM D7127	(2017) Standard Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces using a Portable Stylus Instrument
ASTM E11	(2016) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2008; Corr 1 2009) Quality Management Systems- Requirements

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning
SSPC AB 2	(2015; E 2016) Cleanliness of Recycled Ferrous Metallic Abrasive
SSPC AB 3	(2003; E 2004) Ferrous Metallic Abrasive
SSPC Guide 12	(1998; E 2004) Guide for Illumination of

	Industrial Painting Projects
SSPC Guide 6	(2015) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC PA 2	(2015; E 2018) Procedure for Determining Conformance to Dry Coating Thickness Requirements
SSPC QP 1	(2012; E 2012) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC QP 5	(2012) Standard Procedure for Evaluating the Qualifications of Coating and Lining Inspection Companies
SSPC QS 1	(2015) Standard Procedure for Evaluating a Contractor's Advanced Quality Management System
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP COM	(2016; E 2017) Surface Preparation Commentary for Steel and Concrete Substrates
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-22262	(1993; Rev B; Am 2 1996) Abrasive Blasting Media Ship Hull Blast Cleaning
MIL-DTL-24441	(2009; Rev D) Paint, Epoxy-Polyamide, General Specification for
MIL-DTL-24441/19	(2009; Rev C) Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III
MIL-DTL-24441/31	(2009; Rev B) Paint, Epoxy-Polyamide, White, Formula 152, Type IV
MIL-PRF-85285	(2012; Rev E; Notice 1 2016) Coating: Polyurethane Aircraft and Support Equipment

MIL-STD-161 (2005; Rev G; Notice 1 2010) Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000 Air Contaminants

29 CFR 1910.134 Respiratory Protection

29 CFR 1926.59 Hazard Communication

1.2 DEFINITIONS

Definitions are provided throughout this Section, generally in the paragraph where used, and denoted by capital letters.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05, Design Data

Containment System; G M

SD-06 Test Reports

Joint Sealant Qualification Test Reports; G M

Coatings Qualification Test Reports; G M

Metallic Abrasive Qualification Test Reports; G M

Coating Sample Test Reports; G M

Abrasive Sample Test Reports; G M

Inspection Report Forms; G M

Daily Inspection Reports; G M

Recycled Metallic Abrasive Field Test Reports (Daily and Weekly); G M

SD-07 Certificates

Contract Errors, Omissions, and Other Discrepancies

Corrective Action Procedures

Coating Work Plan

Qualifications of Certified Industrial Hygienist (CIH)

Qualifications Of Individuals Performing Abrasive Blasting

Qualifications of Certified Protective Coatings Specialist (PCS)

Qualifications of Coating Inspection Company

Qualifications of QC Specialist Coating Inspector

Qualifications of Testing Laboratory for Coatings

Qualifications of Testing Laboratory for Abrasive

Qualifications of Coating Contractors

Joint Sealant Materials

Coating Materials

Coating System Component Compatibility

Non-metallic Abrasive

Metallic Abrasive

SD-08 Manufacturer's Instructions

Joint Sealant Instructions

Coating System Instructions

SD-11 Closeout Submittals

Disposal of Used Abrasive; G M/R

Inspection Logbook; G M/R

1.4 QUALITY ASSURANCE

1.4.1 Contract Errors, Omissions, and Other Discrepancies

Submit all errors, omissions, and other discrepancies in contract documents the Contracting Officer within 30 days of contract award for all work covered in this Section, other than the work that will not be uncovered until a later date. All such discrepancies shall be addressed and resolved, and the Coating Work Plan modified, prior to beginning the Initial and Follow-Up phases of work. Discrepancies that become apparent only after work is uncovered shall be identified at the earliest discoverable time and submitted for resolution. Schedule time (Float) should be built into the project schedule at those points where old work is to be uncovered or where access is not available during the first 30 days after award, to allow for resolution of contract discrepancies.

1.4.2 Corrective Action (CA)

CA shall be included in the Quality Control Plan.

1.4.2.1 Corrective Action Procedures

Develop procedures for determining the root cause of each non-compliance, developing a plan to eliminate the root cause so that the non-compliance does not recur, and following up to ensure that the root cause was eliminated. Develop Corrective Action Request (CAR) forms for initiating CA, and for tracking and documenting each step.

1.4.2.2 Implement Corrective Action

The Contractor shall take action to identify and eliminate the root cause of each non-compliance so as to prevent recurrence. These procedures shall apply to non-compliance in the work, and to non-compliance in the QC System. Corrective actions shall be appropriate to the effects of the non-compliance encountered. Each CAR shall be serialized, tracked in a Log to completion and acceptance by the Contracting Officer, and retained in project records. The Corrective Action Log, showing status of each CAR, shall be submitted to the Contracting Officer monthly. A CAR may be initiated by either the Contractor or the Contracting Officer. The Contracting Officer must approve each CAR at the root cause identification stage, the plan for elimination stage, and the close out stage after verification that the root cause has been eliminated.

1.4.3 Coating Work Plan

This work plan shall be considered as part of the Quality Control Plan.

Provide procedures for reviewing contract documents immediately after award to identify errors, omissions, and discrepancies so that any such issues can be resolved prior to project planning and development of detailed procedures.

Provide procedures for verification of key processes during Initial Phase to ensure that contract requirements can be met. Key processes shall include surface preparation, coating application and curing, inspection, and documentation, and any other process that might adversely impact orderly progression of work.

Provide procedures for all phases of coating operations, including planned work, rework, repair, inspection, and documentation. Address mobilization and setup, surface preparation, coating application, coating initial cure, tracking and correction of noncompliant work, and demobilization. Coordinate work processes with health and safety plans and confined space entry plans. For each process, provide procedures that include appropriate work instructions, material and equipment requirements, personnel qualifications, controls, and process verification procedures. Provide procedures for inspecting work to verify and document compliance with contract requirements, including inspection forms and checklists, and acceptance and rejection criteria.

Provide procedures for correcting noncompliant work. Detailed procedures are required in advance to avoid delays in meeting overcoat windows as well as to avoid delays in production. Provide procedures for repairing defects in the coating film, such as runs, drips, sags, holidays, overspray, as well as how to handle correct coating thickness noncompliance, any other areas of repair or rework that might be adversely affected by delays in preparing and approving new procedures.

If a procedure is based on a proposed or approved request for deviation,

the deviation shall be referenced. Changes to procedures shall be noted by submittal number and date approved, clearly delineating old requirements and new requirements, so that the records provide a continuous log of requirements and procedures.

1.4.4 Design Data

1.4.4.1 Containment System

Submit complete design drawings and calculations for the scaffolding and containment system, including an analysis of the loads which will be added to the structure by the containment system and waste materials. A registered engineer shall approve calculations and scaffold system design.

1.4.5 Test Reports

1.4.5.1 Joint Sealant Qualification Test Reports

Submit test results from independent laboratory of representative samples of joint sealant material. Samples must have been tested within the last three years. Submit results as required in paragraph QUALITY ASSURANCE PROVISIONS of ASTM C920. Note that testing in accordance with QUALITY ASSURANCE PROVISIONS is a pre-qualification requirement.

1.4.5.2 Coatings Qualification Test Reports

Submit test results from independent laboratory of representative samples of each coating material. U.S. Department of Defense laboratories are considered to be independent laboratories for purposes of compliance with "QUALIFICATION INSPECTION" requirements herein. Samples must have been tested within the last three years. Submit results for epoxy materials as required in paragraph QUALIFICATION INSPECTION of MIL-DTL-24441, and as revised by paragraph COATING SYSTEM herein. Submit results for polyurethane materials as required in paragraph QUALIFICATION INSPECTION of MIL-PRF-85285, and as revised by paragraph COATING SYSTEM herein. Note that requirement for QUALIFICATION INSPECTION is a pre-qualification requirement, and involves the same testing required for listing in the Qualified Products List of the respective material. See appropriate Military Specification for specific test requirements.

1.4.5.3 Metallic Abrasive Qualification Test Reports

Submit results for abrasive as required in paragraph 4 REQUIREMENTS of SSPC AB 3. Submit test results from independent laboratory of representative samples of each abrasive to be used on the jobsite. Samples must have been tested within the last three years. Note that this testing is for the purpose of prequalifying the abrasive.

1.4.5.4 Recycled Metallic Abrasive Field Test Reports (Daily and Weekly)

Submit test results from independent laboratory of daily and weekly Quality Control testing required by SSPC AB 2, as modified in paragraph ABRASIVE.

1.4.6 Qualifications

1.4.6.1 Qualifications of Certified Industrial Hygienist (CIH)

Submit name, address, telephone number, FAX number, and e-mail address of

the independent third party CIH. Submit documentation that hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification. Provide evidence of experience with hazards involved in industrial coating application work.

1.4.6.2 Qualifications of Certified Protective Coatings Specialist (PCS)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party PCS. Submit documentation that specialist is certified by SSPC: The Society for Protective Coatings (SSPC) as a PCS, including certification number and date of certification/recertification. If the PCS is employed by the same coating inspection company to which the coating inspector is employed, this does not violate the independent third-party requirements. The PCS shall remain certified during the entire project, and the Contracting Officer shall be notified of any change in certification status within 10 days of the change. The PCS shall not be the designated coating inspector.

1.4.6.3 Qualifications of Coating Inspection Company

Submit documentation that the coating inspection company that will be performing all coating inspection functions is certified by SSPC to the requirements of SSPC QP 5 prior to contract award, and shall remain certified while accomplishing any coating inspection functions. The coating inspection company must remain so certified for the duration of the project. If a coating inspection company's certification expires, the firm will not be allowed to perform any inspection functions, and all surface preparation and coating application work must stop, until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in coating inspection company certification status.

1.4.6.4 Qualifications of QC Specialist Coating Inspector

Submit documentation that each coating inspector is employed, and qualified to SSPC QP 5, Level III, by the selected coating inspection company. Each inspector shall remain employed by the coating inspection company while performing any coating inspection functions.

1.4.6.5 Qualifications Of Individuals Performing Abrasive Blasting

Submit name, address, and telephone number of each person that will be performing abrasive blasting. Submit documentation that each blaster is qualified by SSPC to the SSPC C-7 Dry Abrasive Blaster Qualification Program. Each blaster shall remain qualified during the entire period of abrasive blasting, and the Contracting Officer shall be notified of any change in qualification status.

1.4.6.6 Qualifications of Testing Laboratory for Coatings

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that persons performing analyses are qualified.

1.4.6.7 Qualifications of Testing Laboratory for Abrasive

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of abrasive for compliance with specification requirements. Submit documentation that laboratory has experience in testing samples of abrasive for conformance with specifications, and that persons performing analyses are qualified.

1.4.6.8 Qualifications of Coating Contractors

All Contractors and Subcontractors that perform surface preparation or coating application shall be certified to either ISO 9001 or SSPC QP 1 and SSPC QS 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting Contractors and painting Subcontractors must remain so certified for the duration of the project. If a Contractor's or Subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in Contractor certification status.

1.4.6.9 Joint Sealant Materials

Provide manufacturer's certification of conformance to contract requirements.

1.4.6.10 Coating Materials

Provide manufacturer's certification of conformance to contract requirements.

1.4.6.11 Coating System Component Compatibility

Provide certification from each manufacturer of components of the coating system, epoxy primer, epoxy intermediate, and polyurethane topcoat, that the supplied coating material is suitable for use in the specified coating system. Each manufacturer shall identify the specific products, including manufacturer's name, which their product may be used with. The certification shall provide the name of the manufacturer that will provide technical support for the entire system. When all coating materials are manufactured by one manufacturer, this certification is not required.

1.4.6.12 Non-metallic Abrasive

Provide manufacturer's certification that the materials are currently approved by the Naval Sea Systems Command and listed on the Qualified Products Lists (QPL) for the specified materials.

1.4.6.13 Metallic Abrasive

Provide manufacturer's certification of conformance to contract requirements and provide copies of test results.

1.4.7 Protective Coating Specialist (PCS)

The PCS shall be considered a QC Specialist and shall report to the QC

Manager, as specified in Section 01 45 00.00 20 QUALITY CONTROL. The PCS shall approve all submittals prior to submission to the QC Manager for approval or submission to the government for approval.

1.4.8 Pre-Application Meeting

After approval of submittals but prior to the initiation of coating work, Contractor representatives, including at a minimum, project superintendent and QC manager, paint foreman, coating inspector, and PCS shall have a pre-application coating preparatory meeting. This meeting shall be in addition to the pre-construction conference. Specific items addressed shall include: corrective action requirements and procedures, coating work plan, safety plan, coordination with other Sections, inspection standards, inspection requirements and tools, test procedures, environmental control system, safety plan, and test logs. Notify Contracting Officer at least ten days prior to meeting.

1.5 PRODUCT DATA

1.5.1 Joint Sealant Instructions

Submit manufacturer's printed instructions including detailed application procedures, minimum and maximum application temperatures, and curing procedures. Include Safety Data Sheets (SDS) for materials to be used at the job site in accordance with 29 CFR 1926.59.

1.5.2 Coating System Instructions

Submit manufacturer's printed instructions including detailed mixing and application procedures, number and types of coats required, minimum and maximum application temperatures, and curing procedures. Include Safety Data Sheets (SDS) for materials to be used at the job site in accordance with 29 CFR 1926.59.

1.6 DELIVERY AND STORAGE

Ship, store, and handle materials in accordance with SSPC PA 1, and as modified in this Section. Maintain temperature in storage spaces between 5 and 29 degrees C, and air temperature more than 3 degrees C above the dew-point at all times. Inspect materials for damage prior to use and return non-compliant materials to manufacturer. Remove materials with expired shelf life from government property immediately and notify the Contracting Officer.

If materials are approaching shelf life expiration and an extension is desired, samples may be sent to the manufacturer, along with complete records of storage conditions, with a request for shelf life extension. If the manufacturer finds the samples and storage data suitable for shelf life extension, the manufacturer may issue an extension, referencing the product evaluation and the review of storage records. Products may not be extended longer than allowed in the product specification.

1.7 COATING HAZARDS

Ensure that employees are trained in all aspects of the safety plan. Specified coatings may have potential health hazards if ingested or improperly handled. The coating manufacturer's written safety precautions shall be followed throughout mixing, application, and curing of the coatings. During all cleaning, cleanup, surface preparation, and paint

application phases, ensure that employees are protected from toxic and hazardous chemical agents which exceed concentrations in 29 CFR 1910.1000. Comply with respiratory protection requirements in 29 CFR 1910.134. The CIH shall approve work procedures and personal protective equipment.

1.8 JOB SITE REFERENCES

Make available to the Contracting Officer at least one copy each of ASTM D3276, ASTM D3925, ASTM D4285, ASTM D7127, SSPC SP COM, SSPC SP 1, SSPC 7/NACE No.4, SSPC SP 10/NACE No. 2, SSPC PA 1, SSPC PA 2, SSPC Guide 6, SSPC VIS 1, SSPC QP 1, SSPC QS 1, and an SSPC Certified Contractor Evaluation Form at the job site.

PART 2 PRODUCTS

2.1 JOINT SEALANT

TT-S-00230, Type II, Class B

2.2 COATING SYSTEM

Alternate systems or products will not be considered. All primer, intermediate coat and topcoat materials shall be supplied by one supplier. The entire coating system is intended to be applied in the field. Alternatively, surface preparation may be accomplished in the shop, following all temperature, humidity, and testing requirements listed herein, followed by an application of a hold-primer. Remove all shop-applied primer prior to final field surface preparation and coating system application. Adjust all shop preparation to avoid conflicts with final surface preparation requirements.

The Military specification epoxy and polyurethane products specified in this Section do not require approval for listing on the QPL prior to contract award, as indicated in paragraph 3.2 of MIL-DTL-24441 and paragraph 3.1 of MIL-PRF-85285. Testing of products by an independent laboratory to the QUALIFICATION INSPECTION requirements of MIL-DTL-24441 and MIL-PRF-85285prior to contract award is required. See specific submittal requirements in paragraph QUALITY ASSURANCE.

2.2.1 Zinc-Rich Epoxy Primer Coat

Epoxy polyamide, MIL-DTL-24441/19 (Formula 159, Type III).

2.2.2 Epoxy Intermediate Coat

Epoxy polyamide, MIL-DTL-24441/31 (Formula 152, Type IV, White (Tinted)). Tint to approximately SAE AMS-STD-595A color number 27778 parchment using pigment dispersions prepared for epoxy paint tinting. Manufacturer shall tint material and appropriately label. All other requirements of this Military Specification apply.

2.2.3 Polyurethane Topcoat

Polyurethane coating topcoat of MIL-PRF-85285, Type II, White SAE AMS-STD-595A color number 17925.

Modify paragraph 3.6.4 of MIL-PRF-85285, Viscosity and Pot Life, as follows:

The viscosity of the admixed coating, when tested in accordance with ASTM D1200 through a No. 4 Ford cup, shall be as follows:

Time from mix (minimum)	Maximum time through a No. 4 Ford cup
Initially	30 seconds
2 hours	60 seconds
4 hours	No gel

Modify paragraph 3.7.1 of MIL-PRF-85285, Drying Time, as follows:

When applied by spray techniques and when tested in accordance with ASTM D1640/D1640M, the coating shall be set-to-touch within four hours and dry-hard within eight hours (see 4.6 and table I).

2.3 COLOR IDENTIFICATION OF FUEL HANDLING AND STORAGE FACILITIES

Piping, conduit, and tank identification shall be in accordance with MIL-STD-161. Mark direction of fluids in accordance with MIL-STD-161. The NATO symbol for JP-8 is F-34.

2.4 COATING SAMPLE COLLECTION AND SHIPPING KIT

Provide a kit that contains one liter can for the base of each coating material, an appropriately sized can for each activator, dipping cups for each component to be sampled, a shipping box sized for the samples to be shipped, and packing material. Mark cans for the appropriate component. Provide shipping documents, including either pre-paid shipping or a shipper number that can be used by the QC Manager to arrange pickup, addressed to the approved coating testing laboratory.

2.5 ABRASIVE SAMPLE COLLECTION AND SHIPPING KIT

Provide a kit that contains one suitable plastic bag or container for each sample to be collected. Mark containers for the appropriate component. Provide shipping documents, including either pre-paid shipping or a shipper number that can be used by the QC Manager to arrange pickup, addressed to the approved coating testing laboratory.

2.6 TEST KITS

2.6.1 Test Kit for Measuring Chloride, Sulfate and Nitrate Ions on Steel and Coated Surfaces

Provide test kits called CHLOR*TEST CSN Salts, as manufactured by CHLOR*RID International Inc. of Chandler, Arizona (www.chlor-rid.com) or equal. An "equal" test kit shall meet the following requirements:

a. Kit contains all materials, supplies, tools and instructions for field testing and on-site quantitative evaluation of chloride, sulfate and nitrate ions;

b. Kit extract solution is acidic, factory pre-measured, pre-packaged, and of uniform concentration;

c. Kit components and solutions are mercury free and environmentally friendly;

d. Kit contains new materials and solutions for each test extraction;

e. Extraction test container (vessel, sleeve, cell. etc.) creates a sealed, encapsulated environment during salt ion extraction;

f. Test extract container is suitable for testing the following steel surfaces: horizontal (up/down configuration), vertical, flat, curved, smooth, pitted, and rough;

g. All salt ion concentrations are directly measured in micrograms per square centimeter.

2.6.2 Test Kit for Identifying Amine Blush on Epoxy Surfaces

After coating and/or primer has hardened and prior to applying the next coat, test for unreacted amines using the AMINE BLUSH CHECK, manufactured by Elcometer, Rochester Hills, Michigan, or equal. To be considered for approval as an "equal" test kit it shall meet the following requirements:

a. Be a completely self-contained field test kit with all materials, supplies, tools and instructions to perform tests and indicate the presence of unreacted amines;

b. Use an identifiable, consistent, uniform, pre-packaged, factory pre-measured indicating solution;

c. Kit contains no mercury or lead and is environmentally friendly;

d. Kit contains a solution of an unreacted amine for the purpose of "self-checking" the indicator solution;

2.7 ABRASIVE

The referenced abrasive specifications have maximum limits for soluble salts contamination, however, this maximum level of contamination does not guarantee that contamination will not be transferred to the steel surface during abrasive blasting. Other factors such as on-site handling and recycling can allow contamination of abrasive. Contractors are cautioned to verify that the chosen abrasive, along with work and storage processes, allow the final surface cleanliness requirements to be achieved. Successful testing of chlorides in abrasive does not negate the final acceptance testing of steel surfaces.

2.7.1 Non-metallic Abrasive

Conform to MIL-A-22262, Type I (Inorganic materials). Abrasive shall be approved by the Naval Sea Systems Command and listed on the appropriate Qualified Products List (QPL) for the specified materials. Use sampling procedures and testing frequencies as prescribed in MIL-A-22262. Use abrasive that is specifically selected and graded to provide a sharp, angular profile to the specified depth. Do not use ungraded abrasive. Make adjustments to processes or abrasive gradation to achieve specified surface profile. Recycled non-metallic abrasive shall meet all requirements of the specification each time that it is placed in the blast pot.

2.7.2 Metallic Abrasive

2.7.2.1 New and Remanufactured Steel Grit

Conform to the chemical and physical properties of SSPC AB 3 Class 1 (Steel) only, except that the gross gamma radioactivity shall not exceed 5 picocuries per gram. Class 2 (Iron) abrasive shall not be used.

To develop a suitable work mix from new steel abrasive, a minimum of 200 - 400 recycles is required, therefore, it is advantageous for a Contractor to use remanufactured steel grit or grit reclaimed from a previous project. Such grit shall be considered to conform if it can be traced to new grit conforming to SSPC AB 3 Class 1 and it meets all cleanliness requirements of SSPC AB 3 Class 1 when brought to the current jobsite. Submit one representative sample of this work mix to the laboratory for testing, along with samples of new material. Acceptance and use of this work mix shall not be used to justify any deviation from surface preparation requirements.

2.7.2.2 Recycled Steel Grit

Conform to the chemical and physical properties of SSPC AB 2

2.8 WHITE ALUMINUM OXIDE NON-SKID GRIT

Size #60, dust free (washed and dry), minimum 99 percent pure, having the following sieve analysis when tested in accordance with ASTM E11 using a 1000 gramsample:

Sieve #	Percent Retained
40	0
50	15-40
60	60-85

PART 3 EXECUTION

Perform all work, rework, and repair in accordance with approved procedures in the Coating Work Plan.

3.1 COATING AND ABRASIVE SAMPLE COLLECTION AND TESTING

Sample and test materials delivered to the jobsite. Notify Contracting Officer three days in advance of sampling. The QC Manager and either the PCS or coating inspector shall witness all sampling.

3.1.1 Coating Sample Collection

Provide a sample collection kit as required in paragraph COATING SAMPLE COLLECTION AND SHIPPING KIT. From each lot, obtain a one liter sample of each base material, and proportional samples of each activator based on mix ratio, by random selection from sealed containers in accordance with ASTM D3925. Prior to sampling, mix contents of each sealed container to ensure uniformity. As an alternative to collecting small samples from kits, entire kits may be randomly selected and shipped to laboratory, observing all requirements for witnessing and traceability. For purposes

of quality conformance inspection, a lot is defined as that quantity of materials from a single, uniform batch produced and offered for delivery at one time. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Identify samples by designated name, specification number, batch number, project contract number, sample date, intended use, and quantity involved. The QC manager will take possession of the packaged samples, contact the shipping company to arrange for pickup, and relinquish the samples only to the shipping representative for shipment to the approved laboratory for testing as required by the paragraph COATING SAMPLE TEST REPORTS.

3.1.2 Abrasive Sample Collection

Provide a sample collection kit as required in paragraph ABRASIVE SAMPLE COLLECTION AND SHIPPING KIT. For purposes of quality conformance inspection, a lot shall consist of all abrasive materials of the same type from a single, uniform batch produced and offered for delivery at one time. Obtain samples of each abrasive lot using the sampling techniques and schedule of MIL-A-22262. The addition of any substance to a batch shall constitute a new lot. Identify samples by designated name, specification number, lot number, project contract number, sample date, intended use, and quantity involved. The QC manager will take possession of the packaged samples, contact the shipping company to arrange for pickup, and relinquish the samples only to the shipping representative for shipment to the approved laboratory for testing as required by the paragraph ABRASIVE SAMPLE TEST REPORTS.

3.1.3 Coating Sample Test Reports

Submit test results for each lot of coating material delivered to the jobsite. Test samples of primer, intermediate, and topcoat materials for compliance with requirements of Table I. Reject entire lot represented by samples that fail one or more tests, select new lots, and test samples.

3.1.4 Abrasive Sample Test Reports

Submit test results for each lot of abrasive delivered to the jobsite. Test samples of metallic abrasive to the requirements of paragraph REQUIREMENTS of SSPC AB 3, except paragraph 4.1.5 DURABILITY. Test samples of non-metallic abrasive as required in paragraph QUALITY CONFORMANCE INSPECTION of MIL-A-22262. Reject entire lot represented by samples that fail one or more tests, select new lots, and test samples.

3.2 SURFACES TO BE COATED

Coat exterior surfaces of tank, structure, including steel roof, shell, legs, stair, railing, and other exterior appurtenances.

3.3 LIGHTING

Provide lighting for all work areas as prescribed in SSPC Guide 12.

3.4 ENVIRONMENTAL CONDITIONS

3.4.1 Containment

Design and provide a containment system for the capture, containment, collection, storage and disposal of the waste materials generated by the

work under this Section, to meet the requirements of SSPC Guide 6, Class 1. Vapor concentrations shall be kept at or below 10 percent of Lower Explosive Limit (LEL) at all times. Containment may be designed as fixed containment for complete structure or portable containment for sections of structure, however, containment shall remain in any one place from beginning of abrasive blasting through initial cure of coating. Waste materials covered by this paragraph shall not include any material or residue from removal of coatings containing lead, chromium, cadmium, PCB, or any other hazardous material.

It is the Contractors responsibility to insure the feasibility and workability of the containment system. The Contractor shall perform his operations and work schedule in a manner as to minimize leakage of the containment system. The containment system shall be properly maintained and shall not deviate from the approved drawings. If the containment system fails to function satisfactorily, the Contractor shall suspend all operations, except those required to minimize adverse impact on the environment or government property. Operations shall not resume until modifications have been made to correct the cause of the failure.

3.4.2 Automated Monitoring Requirements

Provide continuous monitoring of temperature, relative humidity, and dew point data at pertinent points on the structure, during surface preparation, coating application, and initial cure. Locate sensors to provide pertinent data for the surface preparation and coat application being performed. Monitor any heating, cooling, or dehumidification equipment used. Make data available to the Contracting Officer through Internet access. Provide monitoring equipment to perform as follows:

a. Data is collected in the field unit in one minute increments, and available for download (on-site) in a standard format. Contractor shall collect this data and make available to the Contracting Officer;

b. Monitoring equipment shall have backup power such that data collection and transmission to web server will be uninterrupted during the entire period of the dehumidification requirement;

c. Monitoring equipment shall have capability to measure surface temperatures at a minimum of four locations anywhere on a 150 foot diameter by 50 foot high tank;

d. Monitoring equipment shall have capability to measure interior and exterior dry bulb temperature (DB), relative humidity (RH), and dewpoint temperature (DP);

e. Data shall be available continuously through secure Internet connection, using widely available web browsers;

f. Internet accessible data shall be collected and stored in maximum 15 minute increments, and lag time between data collection and online availability shall be no greater than 70 minutes;

g. Internet accessible data shall be available for viewing online in tabular format, and graphical format using selected data;

h. Internet accessible data shall be available for download in user-defined segments, or entire project to date, in a standard format usable by Microsoft Excel and other spreadsheet programs.

i. Internet-based controls shall provide alerts to pre-designated parties through email messaging;

j. Internet-based controls shall monitor data uploads from field unit and issue alert if data not initiated within 60 minutes of last upload;

k. Internet-based controls shall monitor operation of DH equipment and issues alert when power remains off for more than 15 seconds, or if pre-determined temperature, RH, or DP conditions are exceeded;

The requirements listed here were developed around the Munters Exactaire Monitoring System, as this was the only monitoring system having Internet connectivity known to be commercially available. There is no requirement for connectivity of the monitoring system to control the DH equipment, therefore, any combination of equipment having the required functionality will be accepted.

3.5 SURFACE PREPARATION

3.5.1 Abrasive Blasting Equipment

Use abrasive blasting equipment of conventional air, force-feed, or pressure type. Maintain a minimum pressure of 650 kPa at nozzle. Confirm that air supply for abrasive blasting is free of oil and moisture when tested in accordance with ASTM D4285. Test air quality at each startup, but in no case less often than every five operating hours.

3.5.2 Operational Evaluation of Abrasive

Test abrasive for salt contamination and oil contamination as required by the appropriate abrasive specification daily at startup and every five operating hours thereafter.

3.5.3 Surface Standard

Inspect surfaces to be coated, and select plate with similar properties and surface characteristics for use as a surface standard. Blast clean one or more 300 mm square steel panels as specified in paragraph SURFACE PREPARATION. Record blast nozzle type and size, air pressure at nozzle and compressor, distance of nozzle from panel, and angle of blast to establish procedures for blast cleaning. Measure surface profile in accordance with ASTM D7127. When the surface standard complies with all specified requirements, seal with a clearcoat protectant. Use the surface standard for comparison to abrasive blasted surfaces throughout the course of work.

3.5.4 Pre-Preparation Testing for Surface Contamination

Perform testing, abrasive blasting, and testing in the prescribed order.

3.5.4.1 Pre-Preparation Testing for Oil and Grease Contamination

Inspect all surfaces for oil and/or grease contamination using two or more of the following inspection techniques: 1) Visual inspection, 2) WATER BREAK TEST, 3) CLOTH RUB TEST. Reject oil and/or grease contaminated surfaces, clean using a water based pH neutral degreaser in accordance with SSPC SP 1, and recheck for contamination until surfaces are free of oil and grease.

WATER BREAK TEST - Spray atomized mist of distilled water onto surface, and observe for water beading. If water "wets" surface rather than beading up, surface can be considered free of oil or grease contamination. Beading of water (water forms droplets) is evidence of oil or grease contamination.

CLOTH RUB TEST - Rub a clean, white, lint free, cotton cloth onto surface and observe for discoloration. To confirm oil or grease contamination in lightly stained areas, a non-staining solvent may be used to aid in oil or grease extraction. Any visible discoloration is evidence of oil or grease contamination.

3.5.4.2 Pre-Preparation Testing for Soluble Salts Contamination

Test surfaces for soluble salts, and wash as required, prior to abrasive blasting. Soluble salt testing is also required in paragraph PRE-APPLICATION TESTING FOR SOLUBLE SALTS CONTAMINATION as a final acceptance test of prepared surfaces after abrasive blasting, and successful completion of this phase does not negate that requirement. This phase is recommended since pre-preparation testing and washing are generally more advantageous than attempting to remove soluble salt contamination after abrasive blasting. Effective removal of soluble salts will require removal of any barrier to the steel surface, including rust. This procedure may necessitate combinations of wet abrasive blasting, high pressure water rinsing, and cleaning using a solution of water washing and soluble salts remover. The soluble salts remover shall be acidic, biodegradable, nontoxic, noncorrosive, and after application, will not interfere with primer adhesion. Delays between testing and preparation, or testing and coating application, may allow for the formation of new contamination. Use potable water, or potable water modified with soluble salt remover, for all washing or wet abrasive blasting. Test methods and equipment used in this phase are selected at the Contractor's discretion.

3.5.5 Abrasive Blasting

Abrasive blast steel surfaces to near-white metal in accordance with SSPC SP 10/NACE No. 2. Prepared surfaces shall conform to SSPC VIS 1 and shall match the prepared test-panels. Provide a 50 to 75 micron surface profile. Reject profile greater than 75 microns, discontinue abrasive blasting, and modify processes and materials to provide the specified profile. Measure surface profile in accordance with ASTM D7127, using Rmax as the measure of profile height. Record all measurements required in this standard. Measure profile at rate of three test areas for the first 100 square meters plus one test area for each additional 100 square meters or part thereof. When surfaces are reblasted for any reason, retest profile as specified. Following abrasive blasting, remove dust and debris by vacuum cleaning. Do not attempt to wipe surface clean.

3.5.6 Disposal of Used Abrasive

Dispose of used abrasive off Government property in accordance with Host Nation mandated regulations.

3.5.7 Pre-Application Testing For Surface Contamination

3.5.7.1 Pre-Application Testing for Oil and Grease Contamination

Ensure surfaces are free of contamination as described in paragraph

PRE-PREPARATION TESTING FOR OIL AND GREASE CONTAMINATION, except that only questionable areas need be checked for beading of water misted onto surface.

3.5.7.2 Pre-Application Testing for Soluble Salts Contamination

Test surfaces for chloride contamination using the Test Kit described in TEST KIT FOR MEASURING CHLORIDE, SULFATE AND NITRATE IONS ON STEEL AND COATED SURFACES. Test all surfaces at rate of three tests for the first 100 square meters plus one test for each additional 200 square meters or part thereof. Concentrate testing of bare steel at areas of coating failure to bare steel and areas of corrosion pitting. Perform 30 percent of tests on bare steel at welds, divided equally between horizontal and vertical welds. One or more readings greater than 3 micrograms per square centimeter of chlorides or 10 micrograms per square centimeter of sulfates or 5 micrograms per square centimeter of nitrates is evidence of soluble salt contamination. Reject contaminated surfaces, wash as discussed in paragraph PRE-PREPARATION TESTING FOR SOLUBLE SALTS CONTAMINATION, allow to dry, and re-test until all required tests show allowable results. Reblast tested and cleaned areas as required. Label all test tubes and retain for test verification.

3.5.7.3 Pre-Application Testing for Surface Cleanliness

Apply coatings to dust free surfaces. To test surfaces, apply strip of clear adhesive tape to surface and rub onto surface with finger. When removed, the tape should show little or no dust, blast abrasive, or other contaminant. Reject contaminated surfaces and retest. Test surfaces at rate of three tests for the first 100 square meters plus one test for each additional 100 square meters or part thereof. Provide two additional tests for each failed test or questionable test. Attach test tapes to Daily Inspection Reports.

3.6 MIXING AND APPLICATION OF SEALANT AND COATING SYSTEM

3.6.1 Preparation of Sealant and Coating Materials for Application

Each of the sealant, primer, intermediate, and topcoat materials is a two-component material supplied in separate containers.

3.6.1.1 Mixing Sealant, Primer and Intermediate Coat Materials

Mix in accordance with manufacturer's instructions, which may differ for each product. Do not mix partial kits, or alter mix ratios. Mix materials in same temperature and humidity conditions specified in paragraph DELIVERY AND STORAGE. Allow mixed material to stand for the required induction time based on its temperature.

3.6.1.2 Mixing Topcoat Material

Do not mix partial kits, or alter mix ratios. Mix polyurethane coating materials in same temperature conditions specified in paragraph DELIVERY AND STORAGE. The polyurethane coating material is moisture sensitive and any introduction of moisture or water into the material during mixing or application will shorten usable pot life. Use a mixer that does not create a vortex. Do not add solvent without specific written recommendation from the manufacturer. No induction time is required, only thorough agitation of the mixed material.

3.6.1.3 Pot Life

Apply mixed products within stated pot life for each product. Stop applying when material becomes difficult to apply in a smooth, uniform wet film. Add all required solvent at time of mixing. Do not add solvent to extend pot life. Pot life is based on standard conditions at 21 degrees C and 50 percent relative humidity. For every 10 degrees C rise in temperature, pot life is reduced by approximately half, and for every 10 degrees C drop it is approximately doubled. Usable pot life depends on the temperature of the material at the time of mixing and the sustained temperature at the time of application. Other factors such as the shape of the container and volume of mixed material may also affect pot life. Precooling or exterior icing of components for at least 24 hours to a minimum of 10 degrees C in hot climates will extend pot life. High humidity at time of mixing and application shortens pot life of the Polyurethane topcoat material. Following are approximate pot life times:

Sealant	As specified by manufacturer
Epoxy primer and intermediate materials	4 hours
Polyurethane topcoat materials	2 hours

3.6.1.4 Application Conditions and Recoat Windows

The application condition requirements for the coating system are very time and temperature sensitive, and are intended to avoid the delamination problems frequently found on industrial structures. Plan coating application to ensure that specified temperature, humidity, and condensation conditions are met. If conditions do not allow for orderly application of sealant, primer, stripe coat, intermediate coat and topcoat, use appropriate means of controlling air and surface temperatures, as required. Partial or total enclosures, insulation, heating or cooling, or other appropriate measures may be required to control conditions to allow for orderly application of all required coats.

Maintain air and steel surface temperature between 16 and 38 degrees C during application and the first four hours of cure for epoxy coats and the first eight hours of cure for polyurethane coats. Maintain steel surface temperature more than 3 degrees C above the dew-point of the ambient air for the same period.

Use Table entitled "RECOAT WINDOWS" to determine appropriate recoat windows for each coat after the initial coat. Apply each coat during appropriate RECOAT WINDOW of preceding coat. If a RECOAT WINDOW is missed, the minimum and maximum primer and intermediate coat thickness may be adjusted to accommodate a FILL COAT, however, requirements for total epoxy coating thickness and total coating thickness will not be modified. Missing more than one RECOAT WINDOW may require complete removal of coating if maximum total coating thickness requirements cannot be achieved.

If coating is not applied during RECOAT WINDOW, or if surface temperature exceeds 49 degrees C between applications, provide GLOSS REMOVAL, apply next coat within 24 hours. If next planned coat is topcoat, apply FILL COAT if required to fill sanding marks. Sanding marks from GLOSS REMOVAL of intermediate coat reflecting through topcoat will be considered as noncompliant. Apply FILL COAT within 24 hours of GLOSS REMOVAL, then apply topcoat within RECOAT WINDOW of FILL COAT.

RECOAT WINDOWS						
EPOXY OVER EPOXY						
Temperature degrees C Temperature degrees F	16-21 60-70	22-27 71-80	28-32 12-36	33-38 91-100	39-43 101-110	44-49 111-120
RECOAT WINDOW (Hrs.)	24-72	18-60	16-48	12-36	8-18	4-6
POLYURETHANE OVER EPOXY						
Temperature degrees C Temperature degrees F	16-21 60-70	22-27 71-80	28-32 12-36	33-38 91-100	39-43 101-110	44-49 111-120
RECOAT WINDOW (Hrs.)	24-96	24-72	16-48	12-36	10-24	8-16
POLYURETHANE OVER POLYURETHANE						
Temperature degrees C Temperature degrees F	16-21 60-70	22-27 71-80	28-32 12-36	33-38 91-100	39-43 101-110	44-49 111-120
RECOAT WINDOW (Hrs.)	8-48	6-48	4-36	3-24	2-12	1-2

The temperature ranges shown in the table above are for determining recoat windows. Choose recoat window based on the highest surface temperature that was sustained for one or more hours between coats. This applies to the entire time between coats. Measure and record air and surface temperatures on hourly basis to determine appropriate recoat windows. If surface temperature goes above 38 degrees C, measure and record temperatures every half hour.

FILL COAT - Where indicated, apply coat of intermediate coat epoxy, at 50 to 75 microns DFT, then apply next specified full coat within recoat window of FILL COAT. A FILL COAT may be used to adjust coating thickness to comply with requirements or to fill sanding marks in intermediate coat.

GLOSS REMOVAL - Where required, hand sand in a linear fashion to remove gloss using 120-200 grit wet/dry sandpaper, followed by solvent wiping with a clean rag soaked with denatured alcohol to remove all dust. GLOSS REMOVAL of primer coat is to scarify surface and shall consist of removal of approximately 25 microns of coating. If steel is exposed during GLOSS REMOVAL, repair in accordance with paragraph PROCEDURE FOR HOLIDAY AND SPOT REPAIRS OF NEWLY APPLIED COATING. GLOSS REMOVAL of intermediate coat may include removal of up to 75 microns of coating to avoid excess thickness, prior to application of FILL COAT.

3.6.2 Amine Blush Testing of Epoxy Coat Prior to Overcoating

Test epoxy surfaces prior to application of roof joint sealant, epoxy coat, or polyurethane topcoat for amine blush contamination using the Test Kit described in paragraph TEST KIT FOR IDENTIFYING AMINE BLUSH ON EPOXY SURFACES. Test all surfaces at rate of three tests for the first 100 square meters plus one test for each additional 200 square meters or part thereof. Remove any identified contamination using an approved procedure.

3.6.3 Application of Coating System and Joint Sealant

Apply coatings in accordance with SSPC PA 1 and as specified herein. Apply coatings to surfaces that meet all stated surface preparation requirements.

After application of primer coat and prior to application of each subsequent coat, perform testing prescribed in paragraph PRE-APPLICATION TESTING FOR SURFACE CONTAMINATION, as necessary, to ensure minimal intercoat contamination. This testing may be reduced to one half of the prescribed rate for bare steel if the testing indicates no contamination when sampling is evenly distributed over surfaces being tested. If contamination is found between coats, revert to the specified testing rate. Generally, oil and grease contamination and soluble salts contamination are not encountered if subsequent coats are applied within specified recoat windows and unusual atmospheric events do not occur. Such atmospheric events as a coastal storm blowing onshore can bring unusual chloride contamination. Concern for intercoat contamination should be continually prevalent, and spot testing should be accomplished to verify satisfactory conditions. Where visual examination or spot testing indicates contamination, perform sufficient testing to verify non-contamination, or to define extent of contamination for appropriate treatment.

Apply each coat in a consistent wet film, at 90 degrees to previous coat. Ensure that primer and intermediate coat "cold joints" are no less than 150 mm from welds. Apply stripe coat by brush. For convenience, stripe coat material may be delivered by spray if followed immediately with brush-out and approved procedures include appropriate controls on thickness. Apply all other coats by spray application. Use appropriate controls to prevent airborne coating fog from drifting beyond three meters from the structure perimeter. Cover or protect all surfaces that will not be coated. The cleanliness, temperature, recoat windows, and airborne paint containment requirements may necessitate the use of enclosures, portable shelters, or other appropriate controls.

Apply coatings at the following specified thickness:

Coat	Minimum DFT (Microns)	Maximum DFT (Microns)
Primer	75	125
Intermediate	75	125
Top	50	75
Total system	200	325

3.6.3.1 Application of Primer

Apply primer coat, maintaining paint supply container height within 1 meter of the paint nozzle for applying zinc primer. Maintain constant agitation of paint pot to ensure that zinc does not settle in container.

3.6.3.2 Application of Stripe Coat

Apply a stripe coat of intermediate coat epoxy material within RECOAT WINDOW of primer, allowing sufficient dry time to allow application of intermediate coat within RECOAT WINDOW of primer. Apply by brush, working material into corners, crevices, angles, and welds, and onto outside corners and angles.

3.6.3.3 Application of Intermediate Coat

Apply intermediate coat within RECOAT WINDOW of primer coat.

3.6.3.4 Non-skid for Stairs and Top

Where non-skid is required, apply a second intermediate coat, and immediately follow with application of non-skid grit, broadcast at the rate of 1 kg per 9 square meters, and backroll. Apply topcoat as specified.

3.6.3.5 Application of Topcoat

Make all required repairs to primer and intermediate coats as specified in paragraph entitled "Procedure for Holiday and Spot Repairs of Newly Applied Coating" prior to applying topcoat. Apply topcoat within RECOAT WINDOW of intermediate coat. The polyurethane topcoat may require multiple passes to achieve desired aesthetics and required thickness. Consult manufacturer for thinning and application procedures for anticipated temperature, humidity, and wind conditions. Touch-up blemishes and defects within recoat window of polyurethane topcoat. Retain sample of polyurethane topcoat, from the same batch used to coat structure, to make touch-ups that might be required later.

3.6.3.6 Application of Joint Sealant

Apply joint sealant to back-to-back steel joints that are less than 3/8 inches wide and are not seal welded. Apply sealant to top and bottom, or each side, of narrow joints. Apply sealant within 48 hours of application of the topcoat, and touch-up with topcoat after appropriate cure of the sealant.

3.6.3.7 Procedure for Holiday and Spot Repairs of Newly Applied Coating

Repair coating film defects at the earliest practicable time, preferably before application of the succeeding coat. Observe all requirements for soluble salts contamination, cleanliness between coats, and application conditions. Prepare defective area in accordance with SSPC SP 10/NACE No. 2, and feather coating as required to leave 100 mm of each succeeding coat feathered and abraded. Protect adjacent areas from damage and overspray. Remove dust and solvent wipe the prepared area plus an additional 100 mm beyond the prepared area with clean denatured alcohol. Apply each coat within RECOAT WINDOW of preceeding coat. Within four hours of preparation, apply zinc-rich primer to prepared steel and feather onto prepared primer. Apply intermediate coat to primed area and feather to prepared intermediate area. Apply topcoat to intermediate coat and feather to prepared topcoat. Apply each repair coat to approximate thickness of surrounding coating system.

3.6.3.8 Structure Occupancy After Coating Application

Use clean canvas or other approved shoe covers when walking on coated surfaces, regardless of curing time allowed. For heavily trafficked areas, provide cushioned mats for additional protection.

3.7 PROJECT IDENTIFICATION

At the completion of the work, stencil the following information on the structure in 3/4 to one inch Helvetica style letters of contrasting color using acrylic stencil paint:

Date exterior coated:
Project Number:
Contractor:
Address:
Coating System
Surface Prep: SSPC SP ____ Profile: _____
Primer: _____ Thickness: ____
Intermediate: _____ Thickness: ____
Topcoat: _____ Thickness: ____
Total Thickness: _____

3.8 FIELD QUALITY CONTROL

For marking of tank surfaces, use chalk for marking bare steel, and water based markers for marking coated surfaces, and remove marks prior to coating. Do not use any wax or grease based markers, or any other markers that leave a residue or stain.

3.8.1 Coating Inspector

The coating inspector shall be considered a QC Specialist and shall report to the QC Manager, as specified in Section 01 45 00.00 20 QUALITY CONTROL. The Coating Inspector shall be present during all pre-preparation testing, surface preparation, coating application, initial cure of the coating system, during all coating repair work, and during completion activities as specified in Section 01 45 00.00 20 QUALITY CONTROL. The Coating Inspector shall provide complete documentation of conditions and occurrences on the job site, and be aware of conditions and occurrences that are potentially detrimental to the coating system. The requirements for inspection listed in this Section are in addition to the

QC inspection and reporting requirements specified in Section 01 45 00.00 20 QUALITY CONTROL.

3.8.2 Field Inspection

3.8.2.1 Inspection Requirements

Perform field inspection in accordance with ASTM D3276 and the approved Coating Work Plan. Document Contractor's compliance with the approved Coating Work Plan.

Provide all tools and instruments required to perform the required testing, as well as any tools or instruments that the inspector considers necessary to perform the required inspections and tests. Document each inspection and test, including required hold points and other required inspections and tests, as well as those inspections and tests deemed prudent from on-site evaluation to document a particular process or condition, as follows:

a. Location or area;
b. Purpose (required or special);
c. Method;
d. Criteria for evaluation;
e. Results;
f. Determination of compliance;
g. List of required rework;
h. Observations.

Collect and record Environmental Conditions as described in ASTM D3276 on a 24 hour basis, as follows:

a. During surface preparation, every two hours or when changes occur;
b. During coating application and the first four days of initial cure, every hour, or when changes occur;
c. Note location, time, and temperature of the highest and lowest surface temperatures each day;
d. Use a non-contact thermometer to locate temperature extremes, then verify with contact thermometers.

Document all equipment used in inspections and testing, including manufacturer, model number, serial number, last calibration date and future calibration date, and results of on-site calibration performed.

Document Contractors compliance with the approved Coating Work Plan.

3.8.2.2 Inspection Report Forms

Develop project-specific report forms as required to report measurements, test results, and observations being complete and and conforming to contract requirements. This includes all direct requirements of the contract documents and indirect requirements of referenced documents. Show acceptance criteria with each requirement and indication of conformity of each inspected item. The data may be in any format, but must be legible and presented so that entered data can be quickly compared to the appropriate requirement.

3.8.2.3 Daily Inspection Reports

Submit one copy of daily inspection report completed each day when

performing work under this Section, to the Contracting Officer. Note all non-compliance issues, and all issues that were reported for rework in accordance with QC procedures of Section 01 45 00.00 20 QUALITY CONTROL. Each report shall be signed by the coating inspector and the QC Manager. Submit report within 24 hours of date recorded on the report.

3.8.2.4 Inspection Logbook

A continuous record of all activity related to this Section shall be maintained in an Inspection Logbook on a daily basis. The logbook shall be hard or spiral bound with consecutively numbered pages, and shall be used to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information. The Coating Inspector's Logbook that is sold by NACE is satisfactory. Submit the original Inspection Logbook to the Contracting Officer upon completion of the project and prior to final payment.

3.8.2.5 Inspection Equipment

All equipment shall be in good condition, operational within its design range, and calibrated as required by the specified standard for use of each device.

3.9 FINAL CLEANUP

Following completion of the work, remove debris, equipment, and materials from the site. Remove temporary connections to Government or Contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

TABLE 1

COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ia - Zinc-rich Epoxy Primer Coat MIL-DTL-24441/19 Formula 159

Test	Componenent A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Pigment content, percent (zinc dust)	---	---	81.5	85.5	---	---
Volatiles, percent	42.8	44.3	8.0	8.4	---	---
Non-volatile vehicle percent	53.7	57.7	8.3	8.7	---	---
Weight, Kilograms/liter	0.87	1.01	3.30	3.40	2.80	2.91

TABLE 1

COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ia - Zinc-rich Epoxy Primer Coat MIL-DTL-24441/19 Formula 159

Test	Componenent A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Weight, Pounds/gallon	7.3	8.4	27.5	28.4	23.4	24.4
Flashpoint, Degrees C	35.6	---	37.8	---	---	---
Flashpoint, Degrees F	96	---	100	---	---	---
Consistency, grams	---	---	250	500	150	300
Set to touch time, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	2
Dry hard time, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	8
Pot life, hours at 23 degrees C, 73 degrees F	---	---	---	---	4	---
Sag resistance, Micrometers	---	---	---	---	300	---
Sag resistance, Mils	---	---	---	---	12	---
VOC, Grams/liter	---	---	---	---	---	304
VOC, Pounds/gallon	---	---	---	---	---	2.5

NOTES: Test methods as specified in MIL-DTL-24441.

TABLE 1

COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ib. - Epoxy Intermediate Coat MIL-DTL-24441/31 Formula 152 Type IV (White (Tinted))

Test	Componenent A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Pigment content, percent	44.0	49.0	33.0	38.0	---	---
Volatiles, percent	29.0	35.0	16.0	21.0	---	---
Non-volatile vehicle percent	17.5	23.5	44.0	49.0	---	---
Coarse particles, percent	---	0.3	---	0.3	---	---
Consistency, grams	180	320	300	470	180	245
Weight, Kilograms/liter	1.39	1.45	1.29	1.35	1.34	1.4
Weight, Pounds/gallon	11.6	12.1	10.8	11.3	11.2	11.7
Set to touch time, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	3
Dry hard time, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	8
Fineness of grind, Hegman	4	---	4	---	---	---
Flashpoint, Degrees C	35.5	---	37.8	---	---	---
Flashpoint, Degrees F	96	---	100	---	---	---
Titanium dioxide, percent of pigment	91	---	---	---	---	---
Pot life, hours at 23 degrees C, 73 degrees F	---	---	---	---	4	---
Sag resistance, Micrometers	---	---	---	---	300	---
Sag resistance, Mils	---	---	---	---	12	---

TABLE 1

COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ib. - Epoxy Intermediate Coat MIL-DTL-24441/31 Formula 152 Type IV (White (Tinted))

Test	Componenent A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Color of dry film to approximate color of SAE AMS-STD-595A color 27778	---	---	---	---	---	Conform
Contrast ratio, at 75 micrometers, 3 mils DFT	---	---	---	---	.098	---
Gloss, 60 degree specular	---	---	---	---	35	---
VOC, Grams/liter	---	---	---	---	---	340
VOC, Pounds/gallon	---	---	---	---	---	2.8

GENERAL NOTES: Test methods as specified in MIL-DTL-24441.Where "Conform" is indicated, refer to specific requirements of MIL-DTL-24441/31.

TABLE I

COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ic - Polyurethane TopcoatMIL-PRF-85285 Type II (White and Colors)

Test	Componenent A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Moisture content, percent	---	2	---	---	---	---
Course particles, percent	---	---	---	---	---	.5
Viscosity	---	---	---	---	---	See Note 1
Fineness of grind, Hegman	---	---	---	---	7	---

TABLE I

COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ic - Polyurethane TopcoatMIL-PRF-85285 Type II (White and Colors)

Test	Componenent A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Drying to touch (See Note 2)	---	---	---	---	---	4
Dry-hard (See Note 2)	---	---	---	---	---	8
VOC, grams per liter	---	---	---	---	---	340
Color	---	---	---	---	delta E+-1.0	
Gloss 60 degree specular gloss						
Gloss	---	---	---	---	---	90
Semi-gloss	---	---	---	---	15	45
Opacity	---	---	---	---	0.95	---
Flexibility	---	---	---	---	---	Conform
Fluid resistance	---	---	---	---	---	Conform
Heat resistance (cure)	---	---	---	---	---	Conform
Solvent resistance (cure)	---	---	---	---	---	Conform
Condition in container	---	---	---	---	---	Conform
Odor	---	---	---	---	---	Conform
Lead percent	---	---	---	---	---	0.06
Cadmium percent	---	---	---	---	---	0.06
Chromium percent	---	---	---	---	---	0.00

TABLE I

COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ic - Polyurethane TopcoatMIL-PRF-85285 Type II (White and Colors)

Test	Componenent A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.

NOTES:
(1) Modify paragraph 3.6.4 Viscosity and Pot Life, of MIL-PRF-85285 as follows:

The viscosity of the admixed coating, when tested in accordance with ASTM D1200 through a No. 4 Ford cup, shall be as follows:

Time from mix (minimum)	Maximum time through a No. 4 Ford Cup
Initially	30 seconds
2 hours	60 seconds
4 hours	No gel

(2) Modify paragraph 3.7.1 Drying Time, of MIL-PRF-85285.
When applied by spray techniques and when tested in accordance with ASTM D1640/D1640M, the coating shall be set-to-touch within four hours and dry-hard within eight hours (see 4.6 and table I).

GENERAL NOTES:
Test methods as specified in MIL-PRF-85285, except those marked with "*".
Where "Conform" is indicated, refer to specific requirements of MIL-PRF-85285.

-- End of Section --

SECTION 10 14 00.10

EXTERIOR SIGNAGE
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	(2012) Recommended Practices for Resistance Welding
AWS D1.1/D1.1M	(2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2018) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2015) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 (2006) Metal Finishes Manual

1.2 GENERAL REQUIREMENTS

All exterior signage must be provided by a single manufacturer. Exterior signage must be of the design, detail, sizes, types, and message content shown on the drawings, must conform to the requirements specified, and must be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet must include sign location, sign type, and message. Signs must be complete with lettering, framing as detailed, and related components for a complete installation. Each sample must consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 305 mm square sample of sign face color sample.

1.2.1 Wind Load Requirements

Exterior signage must be designed to withstand 115 km/h windload. Submit design analysis and supporting calculations performed in support of specified signage.

1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings must have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs must be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G M

SD-03 Product Data

Modular Exterior Signage System

Installation

Exterior Signage

Wind Load Requirements

SD-04 Samples

Exterior Signage; G R

SD-10 Operation and Maintenance Data

Protection and Cleaning; G R

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters must be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment must essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials must be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period must be provided.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage must consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage must be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.2.1 Graphics

Signage graphics must conform to the following:

a. Plate aluminum letters, 3 mm thick must be provided and fastened to the message panel with concealed fasteners.

2.2.2 Messages

See drawings for message content. Typeface: and size as indicated on drawings..

2.3 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products must conform to ASTM B209M for sheet or plate, ASTM B221M for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions must be provided at least 3 mm thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products must conform to AWS C1.1M/C1.1.

2.4 ANODIC COATING

Anodized finish must conform to AA DAF45 as follows:

Integrated color anodized designation AA-M10-C22-A32, Architectural

Class 0.010 to 0.018 mm.

Anodized finish must meet the Base Exterior Architectural Plans.

2.5 ORGANIC COATING

Clean, prime and give surfaces a semi-gloss baked enamel finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 0.030 mm. Anodized finish must meet the base exterior architectural plan.

2.6 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting must be 5 to 7 year premium type and must be in accordance with the flammability requirements of ASTM E84 and must be a minimum 0.08 mm film thickness. Film must include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.7 ANCHORS AND FASTENERS

Exposed anchor and fastener materials must be compatible with metal to which applied and must match in color and finish and must be non-rusting, non-corroding, and non-staining. Exposed fasteners must be tamper-proof.

2.8 SHOP FABRICATION AND MANUFACTURE

2.8.1 Factory Workmanship

Work must be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled must be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Welding to or on structural steel must be in accordance with AWS D1.1/D1.1M. Welding must be continuous along the entire area of contact. Exposed welds must be ground smooth. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practical. Items specified to be galvanized must be by hot-dip process after fabrication if practical. Galvanization must be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet must be in accordance with ASTM A924/A924M. Joints exposed to the weather must be formed to exclude water. Drainage and weep holes must be included as required to prevent condensation buildup.

2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces must be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.8.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, must be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of

items to be embedded in concrete must not be painted. Upon completion of work, damaged surfaces must be recoated.

2.9 COLOR, FINISH, AND CONTRAST

Color must be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs must be eggshell, matte, or other non-glare finish. Characters and symbols must contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters must be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message must be included. Signs must be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces must not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials must be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work must be protected against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering must be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions must include simplified diagrams for the equipment as installed. Signs must be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames must be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass must be protected from paint. Finish must be free of scratches or other blemishes.

-- End of Section --

SECTION 10 14 00.20

INTERIOR SIGNAGE
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes
AA PK-1	(2015) Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings & Ingot

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604	(2017a) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G M

SD-03 Product Data

Installation

Warranty

SD-04 Samples

Interior Signage; G R

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G R

Protection and Cleaning; G R

Software

1.3 EXTRA MATERIALS

Provide 5 percent extra frames and extra stock of the following: blank plates of each color and size for sign types. Changeable message strips for sign type. Provide 50 paper inserts and one copy of the software for user produced signs and inserts after project completion and equipment necessary for removal of signage parts and pieces.

1.4 QUALITY ASSURANCE

1.4.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: Directional sign, Standard Room sign, Changeable message strip sign. The samples may be installed in the work, provided each sample is identified and location recorded.

1.4.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials must be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product must be delivered to the jobsite in manufacturer's original packaging and stored in a clean,

dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Warrant the interior signage for a period of 2 years against defective workmanship and material. Warranties must be signed by the authorized representative of the manufacturer. Submit warranty accompanied by the document authenticating the signer as an authorized representative of the guarantor. Guarantee that the signage products and the installation are free from any defects in material and workmanship from the date of delivery.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Signs, plaques, directories, and dimensional letters must be the standard product of a manufacturer regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening. Obtain signage from a single manufacturer with edges and corners of finished letterforms and graphics true and clean.

2.2 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

2.2.1 Standard Room Signs

Signs must consist of acrylic plastic 2 mm thickness minimum conforming to ANSI Z97.1 and must conform to the following:

2.2.2 Changeable Message Strip Signs

Changeable message strip signs must be of same construction as standard room signs to include a clear sleeve that will accept a paper or plastic insert identifying changeable text. The insert must be prepared typeset message mounted on paper card stock. Provide paper and software for creating text and symbols for computers identified by owner for Owner production of paper inserts after project completion. Furnish one suction device to assist in removing face sheet. Sliding inserts or slide knobs that slide horizontally exposing different graphic information must be provided as identified in the signage placement schedule and drawings, attachments.

2.2.3 Type of Mounting For Signs

Provide extruded aluminum brackets for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs must be by mechanical fasteners. Surface mounted signs must be mounted with 1.6 mm thick closed cell vinyl foam with adhesive backing. Adhesive must be transparent, long aging, high tech formulation on two sides of the vinyl foam.

2.2.4 Graphics

Signage graphics for modular signs must conform to the following:

2.2.4.1 Subsurface Copy

Copy is transferred to the back face of clear acrylic sheeting forming the

panel face to produce precisely formed opaque image. This method bonds all sign elements (color, graphics, lettering, Braille and substrate) into a single unit.

2.2.4.2 First Surface Copy Direct Print or Silkscreened (Non-Tactile)

Message may be applied to panel using the silkscreen process. Silkscreened images must be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art is defined as artwork that is a first generation reproduction of the specified art. Edges and corners must be clean.

2.2.4.3 Surface Applied Photopolymer

Integral graphics and Braille achieved by photomechanical stratification processes. Photopolymer used for ADA compliant graphics must be of the type that has a minimum durometer reading of 90. Tactile graphics must be raised 0.8 mm from the first surface of plaque by photomechanical stratification process.

2.2.5 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

2.2.6 Tactile Letters, Symbols and Braille

Raised letters and numbers on signs must conform to 36 CFR 1191.

2.3 BUILDING DIRECTORIES

Building directories must be lobby directories or floor directories, and must be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Dimensions, details, and materials of sign and message content must be as shown on the drawings.

2.3.1 Header Panel

Header panel must be acrylic with raised acrylic letters.

2.3.2 Message Strips

Message Strips must be photo negative type updateable by user.

2.4 METAL PLAQUES

2.4.1 Cast Metal Plaques

2.4.1.1 Border

Border must be flat band.

2.4.1.2 Finish

Letter and emblem Finish	polished
Background Finish	dark aluminum
Background Texture	pebble

2.4.1.3 Mounting

Mounting must be concealed.

2.5 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions must be at least 3 mm thick, and aluminum plate or sheet must be at least 1.3 mm thick. Extrusions must conform to ASTM B221M; plate and sheet must conform to ASTM B209M. Where anodic coatings are specified, alloy must conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes must be as shown. Welding for aluminum products must conform to AWS D1.2/D1.2M.

2.6 ANODIC COATING

Anodized finish must conform to AA DAF45 as follows:

a. Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.010 mm or thicker.

2.7 ORGANIC COATING

Organic coating must conform to AAMA 2604, with total dry film thickness not less than 0.030 mm.

2.8 FABRICATION AND MANUFACTURE

2.8.1 Factory Workmanship

Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practicable.

2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.9 COLOR, FINISH, AND CONTRAST

Color must be as indicated. Finish of all signs must be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

2.10 TYPEFACE

ADA-ABA compliant font for Room Signs.

PART 3 EXECUTION

3.1 INSTALLATION

Signs must be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Submit six copies of operating instructions outlining the step-by-step procedures required for system operation. The instructions must include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set must be permanently bound and must have a hard cover. The following identification must be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Mounting height and mounting location must conform to 36 CFR 1191. Required blocking must be installed. Signs on doors or other surfaces must not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces must be installed with matching blank back-up plates in accordance with manufacturer's instructions.

Do not install items that show visual evidence of biological growth.

3.1.1 Anchorage

Anchorage must be in accordance with approved manufacturer's instructions. In high humidity interior spaces (for example, bathrooms, locker rooms, pools, trainers) and unconditioned spaces, use corrosion-resistant anchors/fasteners or with approval by the manufacturer, waterproof silicone adhesive. Anchorage not otherwise specified or shown must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials must be compatible with metal to which applied and must have matching color and finish. At interior applications in heavy traffic areas, firmly attach signage to structure walls with tamper-proof fasteners.

a. Signs mounted to painted gypsum board surfaces must be removable for painting maintenance.

b. Mount signs mounted to lay-in ceiling grids with clip connections to ceiling tees.

c. Install signs mounted on metal surfaces with magnetic tape.

d. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.

3.1.2 Protection and Cleaning

Protect the work against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions and the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, Package 1. Submit six copies of maintenance instructions listing routine procedures, repairs, and guides.

-- End of Section --

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SECTION 10 26 00

WALL AND DOOR PROTECTION
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F476	(1996) Standard Test Methods For Security Of Swinging Door Assemblies
ASTM G21	(2015) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1545	(2005; R 2014) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall Covering/Panels; G M

SD-03 Product Data

Wall Covering/Panels

SD-04 Samples

Finish; G R

SD-06 Test Reports

Wall Covering/Panels; G M

Indoor air quality for wall covering/panels

Indoor air quality for adhesives

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality

1.3.1.1 Wall Covering/Panels

Provide sheet and high impact resistant resilient materials certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.3.1.2 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this section. Provide current product

certification documentation from certification body When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the product site in an unopened original factory packaging clearly labeled to show manufacturer. Store materials in undamaged packaging in a clean, dry place out of direct sunlight and exposure to the elements. A minimum room temperature of 4 degrees C and a maximum of 38 degrees C should be maintained. Materials must be stored flat.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

To the maximum extent possible, wall covering must be the standard products of a single manufacturer and must be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

2.1.1 Resilient Material

Provide wall protection components that have been tested in accordance with the applicable provisions of ASTM F476, as well as resilient material consisting of high impact resistant extruded acrylic vinyl, or injection molded thermal plastic conforming to the following:

2.1.1.1 Minimum Impact Resistance

Minimum impact resistance must be 960.8 N-m/m when tested in accordance with ASTM D256, (Izod impact, ft-lbs per sq inch notched).

2.1.1.2 Fire Rating

Fire rating must be Class 1 when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material must be rated self extinguishing when tested in accordance with ASTM D635. Material must be labeled and tested by an approved nationally known testing laboratory. Resilient material used for protection on fire rated doors and frames must be listed by the testing laboratory performing the tests. Resilient material installed on fire rated wood/steel door and frame assemblies must have been tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly will not be acceptable.

2.1.1.3 Integral Color

Colored components must have integral color and must be matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.1.1.4 Chemical and Stain Resistance

Provide wall protection system components with chemical and stain Resistance in accordance with ASTM F476.

2.1.1.5 Fungal and Bacterial Resistance

Materials must be resistant to fungi and bacteria in accordance with ASTM G21, as applicable.

2.2 WALL COVERING/PANELS

Provide wall covering/panels consisting of high impact rigid acrylic vinyl. Panel sizes must be 600 mm x 1200 mm. Submit fire rating and extinguishing test results for resilient material. Also submit statements attesting that the items comply with specified fire and safety code requirements. Provide wall covering material used on the interior of the building (defined as inside of the weatherproofing system) that meets either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for wall covering/panels.

2.2.1 Rigid Vinyl Acrylic Wall Covering

Wall covering thickness must be 1.02 mm.

2.3 TRIM, FASTENERS AND ANCHORS

Provide rubber wall base, fasteners and anchors for each specific installation as shown.

2.4 FINISH

Submit three samples indicating color and texture of materials requiring color and finish.

2.4.1 Resilient Material Finish

Finish for resilient material must be stipple texture with colors in accordance with SAE J1545.

2.5 ADHESIVES

Adhesive for resilient material must be in accordance with manufacturers recommendations. Provide sealants and non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.6 COLOR

Color must be selected from manufacturers standard colors. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth.

-- End of Section --

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SECTION 10 28 13

TOILET ACCESSORIES
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1036	(2016) Standard Specification for Flat Glass

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes

Accessory Items

Recycled content for stainless steel toilet accessories

SD-04 Samples

Finishes; G R

Accessory Items; G R

SD-07 Certificates

Accessory Items

1.3 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories where indicated in accordance with paragraph 3.3 SCHEDULE below. Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

Provide stainless steel products listed herein manufactured from materials containing a minimum of 50 percent recycled content. Provide data identifying percentage of recycled content for stainless steel toilet accessories.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide oval heads exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below. Submit fasteners proposed for use for each type of wall construction, mounting, operation, and cleaning instructions and one sample of each other accessory proposed for use. Incorporate approved samples into the finished work, provided they are identified and their locations noted. Submit certificate for each type of accessory specified, attesting that the items meet the specified requirements.

2.2.1 Grab Bar (GB)

Provide an 18 gauge, 32 mm grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated on drawings. Provide concealed mounting flange. Provide grab with satin finish. Furnish installed bars capable of withstanding a 2.225 kN vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 38 mm space between wall and grab bar.

2.2.2 Mirrors, Glass with Stainless Steel Frame (MG)

Provide Type I transparent flat type, Clss 1-clear glass for mirrors. Glazing Quality q1 6 mm thick conforming to ASTM C1036. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed

through 6 mm thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication. Construct a Type 304 stainless steel frame for mirror per dimensions indicated on drawings.

2.2.3 Mirrors, Wall Mounted Magnifying Mirror (MM)

Provide 2 adjustable wall mounted magnifying mirrors with 300 mm min extension length, round shaped with minimum 200 mm diameter, two sided with fog resistance finish and stainless steel framing and 360-degree swivel design with 1x and 5x magnification options.

Mirrors to be used in Consolidated Utility Building Addition for chemical feed monitoring. Locations are indicated on Process Mechanical and Architectural drawings.

2.2.4 Combination Paper Towel Dispenser/Waste Receptacle (PTDWR)

Provide semi-recessed dispenser/receptacle with a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Design waste receptacle to be locked in unit and removable for service. Provide tumbler key locking mechanism. Fabricate a minimum 0.7 mm stainless steel welded construction unit with all exposed surfaces having a satin finish. Provide waste receptacle that accepts reusable liner standard for unit manufacturer.

2.2.5 Soap Dispenser (SD)

Provide soap dispenser surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 1.2 L with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.6 Toilet Tissue Dispenser (TTD)

Furnish Type II surface mounted toilet tissue holder with two rolls of standard tissue stacked vertically. Provide stainless steel, satin finish cabinet.

2.2.7 Mop and Broom Holder (MH)

Stainless steel with grip jaw cam mechanism securing 4 mop or broom handles. Also includes hooks and storage shelf.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory

manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulfide sealant) as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, PTFE or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

3.3 SCHEDULE

Accessories Required						
Room or Space	MG	TTD	PTWR	SD	GB	MH
Room 106 (Toilet Room) in SFUS Building	1	1	1	1	2	1

-- End of Section --

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SECTION 10 44 16

FIRE EXTINGUISHERS
05/15

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Extinguishers; G M

Accessories; G M

Wall Brackets; G M

SD-03 Product Data

Fire Extinguishers

Accessories

Wall Brackets

Replacement Parts List

SD-04 Samples

Wall Brackets; G R

Accessories; G R

SD-07 Certificates

Fire Extinguishers

Manufacturer's Warranty with Inspection Tag

1.2 DELIVERY, STORAGE, AND HANDLING

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

1.2.1 Samples

Provide the following samples: three samples of wall brackets and accessories of each type being used.

Use approved samples for installation, with proper identification and storage.

1.3 Warranty

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than 6 years after completion. Submit the manufacturer's warranty with inspection tag.

PART 2 PRODUCTS

Submit fabrication drawings consisting of fabrication and assembly details performed in the factory and product data for the following items: Fire Extinguishers, Accessories, Wall Brackets.

2.1 SYSTEM DESCRIPTION

2.1.1 Type

Foam - Foam extinguishers are for Class A and B fires only (common combustibles, flammable liquids and gases).

Submit fire extinguishers certifications showing compliance with local codes and regulations.

2.1.2 Material

Provide aluminum enameled steel extinguisher shell.

2.1.3 Size

4.5 kilogram extinguishers.

2.1.4 Accessories

Forged brass valve

Fusible plug

Safety release

Pressure gage

2.2 EQUIPMENT

2.2.1 Wall Brackets

Provide wall-hook fire extinguisher wall brackets.

Provide wall bracket and accessories as approved.

PART 3 EXECUTION

3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation. Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers

complete with Manufacturer's Warranty with Inspection Tag attached.

Comply with the manufacturer's recommendations for all installations.

3.2 PROTECTION

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Submit replacement parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

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SECTION 10 56 29.16 25

PALLET STORAGE RACKS
03/17
NAVFAC SE VERSION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100	(1991; R 2008) Cold-Formed Steel Design Manual
AISI S100	(2012) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F436	(2011) Hardened Steel Washers

MATERIAL HANDLING INDUSTRY OF AMERICA (MHI)

MHI MH16.1	(2012) Specification for Industrial Steel Storage Racks

MHI MH26.2 (2007) Specification for Welded Wire Rack Decking

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (2016; TIA 16-1; TIA 16-2; TIA 16-3 2016; Errata 17-1; Errata 17-2) Standard for the Installation of Sprinkler Systems

NFPA 15 (2017; ERTA 2017) Standard for Water Spray Fixed Systems for Fire Protection

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-440-01 (2014) Warehouses and Storage Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation instructions

Pallet Storage Racks

Recycled Content

Safety Accessories

SD-05 Design Data

Load Application and Rack Configuration Drawings; G M

SD-11 Closeout Submittals

Recycled Content; G M/R

1.3 DESIGN PARAMETERS

Pallet Storage Racks must be designed for safe storage of palletized loads based on standard pallet sizes and maximum allowable overhang. The standard cargo load size for a pallet is 1020 mm x 1220 mm x 915mm. The average storage load is 1020 mm x 1220 mm x 730 mm. A 1220 mm vertical pallet rack beam spacing is provided by the standard pallet rack configuration for this average height load. Maximum DOD allowances for loaded pallets with overhanging loads are 1090 mm x 1320mm. Planning must accommodate such vertical dimensions or be adjusted where loads differ significantly from the average height.

Pallet storage rack heights are limited to standard forklift equipment stacking capability in accordance with UFC 4-440-01. Pallet orientation for rack storage will be short length facing aisle, long length placed front-to-back of rack. Provide welded-wire rack decking supporting the

load, designed in accordance with MHI MH26.2, maintaining more than 50 percent openings within the rack shelf area.

a. Configuration:

(1) Triple-Row Pallet Storage Rack

(a) Plan for a 915 mm vertical pallet rack beam spacing.

(b) Plan for a 1220 mm front-to-back depth.

(c) Plan for a 2744 mm beam length between uprights.

Full Pallet Rack Dimensions: 3658 mm H x 2744 mm W x 1220 mm D

1.4 DESIGN DATA AND DRAWINGS

Load Application and Rack Configuration Drawings must be based on the AISI D100 provisions for Load and Resistance Factor Design (LRFD) or provisions for Allowable Strength Design (ASD). Use ASCE 7 load combinations and load factors based on project location. Design for maximum concentrated loads and maximum uniformly distributed standard cargo loads. Provide seismic design and bracing based on project location. Provide design loads for the floor areas of the pallet storage rack configuration. Provide configuration details of the storage pallet racks showing column locations, beams, base plates, bracing, and anchoring. Load Application and Rack Configuration Drawings must be evaluated by Contractor's professional structural engineer, signed and sealed.

1.4.1 Upright Frame Design

Upright frame assembly consists of columns and bracing members. Design for critical combinations of vertical and horizontal loads, include moments and forces induced into columns by pallet rack beams. Provide column and bracing member designs in accordance with the effective length method specified in MHI MH16.1, or AISC 360, or AISI S100. Use one design method consistently throughout the analysis. Note the design method on the Load Application and Rack Configuration Drawings. Include the following analyses for effective lengths:

a. Flexural buckling in the direction perpendicular to the upright frame. Include racks not braced against sidesway as well as braced against sidesway.

b. Flexural buckling in the plane of the upright frame. Evaluate a combination of diagonal and horizontal bracing intersecting the column. Evaluate diagonal bracing intersecting horizontal braces.

Analyze and design the upright frame joints and connections with the transfer of member forces into and through those joints and connections. Analyze and design for deformation of the members and stiffening elements coming into each joint and connection. Multiple slot or fastener holes are provided within the upright universal tear drop frame for adjusting rack levels.

1.4.2 Overturning Stability

Pallet storage rack assemblies must be attached to the floor and each

other.

a. Pallet storage rack assemblies exceeding a 6:1 height to depth ratio must be designed to resist a side force applied to any single frame at the top loaded shelf level, in a direction perpendicular to the aisle.

b. Pallet storage rack assemblies exceeding a 6:1 height to depth ratio must be evaluated and if required, supplemented with external bracing, in addition to being anchored to the concrete floor.

c. Row Spacer: Provide row spacers for double-row and triple row configuration. Design basis in accordance with UFC 4-440-01 and NFPA 13.

Attachments to buildings, if any, must be designed and installed to prevent building reactions and displacements from damaging the pallet storage rack assembly or to prevent reactions and displacements from the pallet storage rack assembly from damaging the building. Attachments to buildings must be evaluated by Contractor's professional structural engineer and noted on the Load Application and Rack Configuration Drawings.

1.4.3 Pallet Rack Beam

Bending moments, reactions, shear forces, and deflections shall be determined by simple supported beam analyses, or by rational analysis for beams having partial end fixity. Determine pallet rack beam sizes loaded by conventional methods according to AISI S100 or AISC 360.

1.4.3.1 Pallet Rack Beam Connection

Provide bolted beam connection capable of resisting an upward force of 70-80 KSI per bolted connection without failure or disengagement.

1.4.3.2 Pallet Load Support Member

Pallet load support members located between the pallet rack beams must be designed for the worst loading condition. Pallet load support members are to be mounted at the same height as the pallet rack beam.

1.4.3.3 Bottom Pallet Rack Level

The bottom pallet rack level must be 304 mm above the finish floor elevation.

1.4.4 Bearing on Concrete

Provide base plate design transferring column forces and moments into the concrete floor determined by rational analysis in accordance with MHI MH16.1. Maximum allowable bearing stress or design bearing load on the bottom of the plate must be based on project concrete minimum 28 day compression design strength or less; existing concrete floors to assume. Provide location, size, and pressures under the column base plates.

a. Anchor bolt design must be in accordance with ACI 318. Note the grade, diameter and length of the bolt on the Load Application and Rack Configuration Drawings.

(1) Anchor bending associated with shims or grout under the base plate

must be accounted for in the anchor bolt design.

b. Confirm existing concrete floor tolerance meets EXECUTION Examination subparagraph requirements. Notify Contracting Officer prior to starting the Load Application and Rack Configuration Drawings if the floor tolerances are inadequate, and do not proceed further until the Contracting Officer provides direction.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original packages, containers or bundles bearing the brand name and identification of the manufacturer. Store inside under cover. Protect surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide Pallet Storage Racks according to MHI MH16.1 and MHI MH26.2.

SSI SCHAFER - (144"h x 108"w x 48"D Pallet rack with Wire Decking) was used as a basis of design.

2.2 MATERIAL QUALITY

Provide Pallet Storage Racks component members using structural steel quality defined by the specifications of the American Society for Testing and Materials (ASTM) listed in AISI S100 for cold-formed component members and AISC 360 for hot-rolled component members. Upright frames must be constructed with tensile strength steel or higher. Upright frame columns must be factory welded to base plates.

2.2.1 Finish

2.2.1.1 Racks located within conditioned spaces

Provide cold-formed and hot-rolled component members with an applied dry powder coating system. Use pretreatment preparation methods to provide clean and suitable surfaces prior to electrospraying powder coating in accordance with the latest Powder Coating Institute Guidelines for Powder Coating Various Substrates, so that the applied coating system can develop the adhesion necessary for a satisfactory service life.

2.2.1.2 Finish Color

Provide upright frames in the manufacturer's standard colors. Provide safety yellow color to rack beams and column post protectors.

2.2.2 Recycled Content

Use steel materials manufactured from a Basic Oxygen Furnace (BOF) containing 16 percent or better postconsumer recycled steel content or from an Electric Arc Furnace (EAF) containing 67 percent or better postconsumer recycled content.

2.3 SAFETY ACCESSORIES

Provide safety accessory material quality and finish matching pallet storage rack structural steel components.

a. Column Post Protectors: Provide a heavy gauge structural steel, 305 mm high column post protector. Provide pot protector for each aisle front and row end columns. Post protector must be angled to deflect a forklift or cargo moved by a forklift from direct impact. Mount to column or floor; post protector can be welded or bolted to column; or bolted to floor.

2.4 BASE PLATE

Provide base plate with offset anchoring holes to position anchor bolts behind the upright frame columns and not exposed to aisle traffic.

2.5 SHIMS

Shims must be made of a material that meets or exceeds the design bearing strength or allowable bearing strength of the concrete floor. The shim size must be equal to or greater than the required base plate size.

2.6 FASTENERS

Provide base plate anchor bolts per ASTM F1554 standard; Nuts per ASTM A563 standard and heavy hex style, hot dip or mechanical zinc coated; Washers per ASTM F436 standard and hot dip or mechanical zinc coated.

2.7 PLAQUE

Provide metal signage based upon the custom design data from the load application and rack configuration drawings. Plaque area not less than 32260 square millimeters. Plaque data must show the maximum permissible unit load and/or maximum uniformly distributed load per level, and the maximum total load per bay. Unit load is typically a single pallet. Racks having multiple stacking of unit loads must be identified. Provide reflective, contrasted background and text signage that is laminated per row.

PART 3 EXECUTION

3.1 EXAMINATION

Before installation, examine components for dents and scratches. Replace damaged components.

a. Examine concrete floor designated within the rack storage area (pallet storage racks and aisles).

    (1) Storage heights exceeding 40,000 mm with planned aisle widths less than 8,000 mm require superflat tolerance, Class 9 floor per ACI 302.1R. Storage heights and aisle widths not meeting the above criteria, require industrial tolerance, Class 5 floor per ACI 302.1R. Notify Contracting Officer if floor tolerance does not comply and do not proceed with erection until further direction from Contracting Officer.

b. Examine steel columns designated within the rack storage area. If rack storage area is greater than 305 mm, verify steel columns have one of the requisite fire protection standards: 2-hour fire rated protection, an applied 2-hour fireproofing, or sidewall sprinkler protection at elevation intervals pointing directly at the steel

column and in accordance NFPA 15.

(1) If steel column is not fire protected, notify Contracting Officer and do not proceed with erection until further direction from the Contracting Officer.

3.2 ERECTION

Erect pallet storage racks according to manufacturer's installation instructions. Make wall and floor connections as indicated.

3.2.1 Plaque

Display plaque(s) at conspicuous eye level location per row.

-- End of Section --

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SECTION 13 34 19

METAL BUILDING SYSTEMS
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2011) Steel Construction Manual
AISC 341	(2010) Seismic Provisions for Structural Steel Buildings
AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2004) Standard Definitions for Use in the Design of Steel Structures
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2011) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved

	Formability, and Ultra-High Strength
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	(2017) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325M	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A475	(2003; R 2014) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A500/A500M	(2018) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501/A501M	(2014) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A529/A529M	(2014) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A572/A572M	(2018) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A606/A606M	(2008) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	(2018) Standard Specification for Steel

	Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A755/A755M	(2018) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	(2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A992/A992M	(2011; R 2015) Standard Specification for Structural Steel Shapes
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B695	(2004; R 2016) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1363	(2011) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C518	(2017) Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C665	(2017) Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded

	Rubber
ASTM D1308	(2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2015) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D522/D522M	(2014) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2017) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM DEFONLINE	(2008) ASTM Online Dictionary of Engineering Science and Technology
ASTM E1592	(2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E1646	(1995; R 2018) Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Air Pressure Difference
ASTM E1680	(2016) Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems

ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	(2014) Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM F436	(2011) Hardened Steel Washers
ASTM F436M	(2011) Hardened Steel Washers (Metric)
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2012) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2017) The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 15	(1999; E 2004) Steel Joist Shop Primer
SSPC Painting Manual	(2002) Good Painting Practice, Steel Structures Painting Manual, Volume 1
SSPC SP 2	(1982; E 2000; E 2004) Hand Tool Cleaning

1.2 GENERAL REQUIREMENTS

1.2.1 Structural Performance

Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within the limits and conditions indicated.

1.2.1.1 Engineering

Design metal building systems conforming to procedures described in MBMA MBSM.

1.2.1.2 Design Loads

Conform to the requirements of MBMA MBSM, ASCE 7, and the building code applicable to the project geographical location.

1.2.1.3 Live Loads

Include all vertical loads induced by the building occupancy indicated on the drawings, as well as loads induced by maintenance workers, materials and equipment for roof live loads.

1.2.1.4 Wind Loads

Include horizontal loads induced by the basic wind speed indicated on the Drawings.

1.2.1.5 Collateral Loads

Include additional dead loads other than the weight of metal building system for permanent items such as sprinklers, mechanical systems, electrical systems, and ceilings.

1.2.1.6 Auxiliary Loads

Include dynamic live loads, such as those generated by cranes and materials-handling equipment indicated on detail drawings.

1.2.1.7 Load Combinations

Design metal building systems to withstand the most critical effects of load factors and load combinations as required by MBMA MBSM, ASCE 7, and the building code applicable to the project location.

1.2.1.8 Deflection Limits

Engineer assemblies to withstand design loads with deflections no greater than the following:

a. Purlins and Rafters; vertical deflection of 1/240 of the span.

b. Girts; horizontal deflection of 1/240 of the span.

c. Metal Roof Panels; vertical deflection of 1/180 of the span.

d. Metal Wall Panels; horizontal deflection of 1/180 of the span.

Design secondary framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E1592.

1.2.2 Seismic Performance

Design and engineer metal building system capable of withstanding the effects of earthquake motions determined according to ASCE 7, AISC 341, and the applicable portions of the building code in the geographic area where the construction will take place.

1.2.3 Thermal Movements

Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss as follows:

Temperature Change (Range); 67 C, ambient; 100 C 100 C, material surfaces.

1.2.4 Thermal Performance

Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C1363 or ASTM C518.

1.2.4.1 Metal Roof Panel Assemblies

a. U-Factor: 0.025

b. R-Value: 40

1.2.4.2 Metal Wall Panel Assemblies

a. U-Factor: 0.05

b. R-Value: 20

1.2.5 Air Infiltration for Metal Roof Panels

Air leakage through assembly must not exceed 0.3 L/s per sq. m of roof area when tested according to ASTM E1680 at negative test-pressure difference of 75 Pa.

1.2.6 Air Infiltration for Metal Wall Panels

Air leakage through assembly of not more than 0.3 L/s per sq. m of wall area when tested according to ASTM E283 at static-air-pressure difference of 300 Pa.

1.2.7 Water Penetration for Metal Roof Panels

No water penetration when tested according to ASTM E1646 at test-pressure difference of 137 Pa.

1.2.8 Water Penetration for Metal Wall Panels

No water penetration when tested according to ASTM E331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 300 Pa and not more than 575 Pa.

1.2.9 Wind-Uplift Resistance

Provide metal roof panel assemblies that comply with ASCE 7.

1.2.10 Lifting Plan

Submit a lifting plan using form 16-3 in accordance with section 16 of EM 385 30 days prior the pre-erection conference Indicate required crane lifting requirements, temporary support structures, member size and locations of braced or guyed temporary supports, and locations of bracing or guys anchor points. Clearly define the required framing sequence and conditions necessary to insure the structure is maintained in a properly braced and stable condition throughout the complete erection process.

1.3 DEFINITIONS

ASTM DEFONLINE applies to this definition paragraph.

a. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.

b. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).

c. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).

d. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a

rafter frame or knee).

e. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).

f. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.

g. Terminology Standard: Refer to MBMA "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 SYSTEM DESCRIPTION

General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.

Provide metal building system of size and with spacing, slopes, and spans indicated.

1.4.1 Primary Frame Type

a. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

b. Lean To: Solid- or truss-member, structural-framing system without interior columns, designed to be partially supported by another structure.

1.4.2 End-Wall Framing

Provide primary frame (rigid clear span), for buildings not required to be expandable, consisting of rigid clear span frame, capable of supporting one-half of a bay design load. End-wall columns must be non-load bearing wind columns for girt attachment.

1.4.3 Secondary Frame Type

Provide manufacturer's standard purlins and joists and exterior-framed (bypass) girts.

1.4.4 Eave Height

Eave height must be Manufacturer's standard height, as indicated by nominal height on Drawings.

1.4.5 Bay Spacing

Bay Spacing must be as determined by manufacturer.

1.4.6 Roof Slope

Roof slope must be 1:12.

1.4.7 Roof System

Provide manufacturer's standard standing-seam metal roof panels on a waterproof membrane, on protection board on rigid insulation on metal deck.

1.4.8 Exterior Wall System

Provide manufacturer's standard factory-assembled, insulated metal wall panels complete with vapor barrier conforming to ASTM E96/E96M.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G M/R

Lifting Plan; G M/R

SD-02 Shop Drawings

Detail Drawings; G M

SD-03 Product Data

Manufacturer's Catalog Data

SD-04 Samples

Coil Stock, 304.8 mm long by the actual panel width; G R

Roof Panels, 304.8 mm long by actual panel width; G R

Wall Panels, 304.8 mm long by actual panel width; G R

Fasteners; G R

Metal Closure Strips 250 mm long of each type; G R

Insulation, approximately 200 by 280 mm; G R

SD-05 Design Data

Manufacturer's Descriptive and Technical Literature; G M

Manufacturer's Building Design Analysis; G M

SD-06 Test Reports

Test Reports; G M

Coatings and Base Metals; G M

Factory Color Finish Performance Requirements; G M

SD-07 Certificates

System Components

Coil Stock Certification

Aluminized Steel Repair Paint

Galvanizing Repair Paint

Enamel Repair Paint

Qualification of Manufacturer

Qualification of Erector

SD-08 Manufacturer's Instructions

Shipping, Handling, and Storage

SD-11 Closeout Submittals

Manufacturer's Warranty; G M/R

Contractor's Warranty for Installation; G M/R

1.6 QUALITY ASSURANCE

1.6.1 Pre-Erection Conference

After submittals are received and approved but before metal building system work, including associated work, is performed, the Contracting Officer will hold a pre-erection conference to review the following:

a. The detail drawings, specifications, and manufacturer's descriptive and technical literature.

b. Finalize construction schedule and verify availability of materials, erector's personnel, equipment, and facilities needed to make progress and avoid delays.

c. Methods and procedures related to metal building system erection, including, but not limited to: qualification of manufacturer, qualification of erector, manufacturer's catalog data, manufacturer's building design analysis, written instructions and test reports.

d. Support conditions for compliance with requirements, including alignment between and erection of structural members.

e. Flashing, special roofing and siding details, roof and wall penetrations, openings, and condition of other construction that will affect metal building system, including coatings and base metals, factory color finish performance requirements, system components, and certificates for coil stock.

f. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.

g. Temporary protection requirements for metal panel assembly during and after installation.

h. Samples of aluminized steel repair paint, galvanizing repair paint, and enamel repair paint.

1.6.1.1 Pre-Roofing and Siding Installation Conference

After structural framing system erection and approval but before roofing, siding, insulation work, including associated work, is performed; the Contracting Officer will hold a pre-roofing and siding conference to review the following:

a. Examine purlins, sub-girts and formed shapes conditions for compliance with requirements, including flatness and attachment to structural members.

b. Review structural limitations of purlins, sub-girts and formed shapes during and after roofing and siding.

c. Review flashings, special roof and wall details, roof drainage, roof and wall penetrations, roof equipment curbs, and condition of other construction that will affect the metal building system.

d. Review temporary protection requirements for metal roof and wall panels' assembly during and after installation.

e. Review roof and wall observation and repair procedures after metal building system erection.

1.6.2 Manufacturer's Qualifications

Metal building system manufacturer must have a minimum of five (5) years experience as a qualified manufacturer and a member of MBMA of metal building systems and accessory products.

Provide engineering services by an authorized currently licensed engineer in the geographical area where construction will take place, having a minimum of four years experience as an engineer knowledgeable in building design analysis, protocols and procedures for the "Metal Building Systems Manual" (MBMA MBSM); ASCE 7, and ASTM E1592.

Submit copies of the building design analysis calculations with the drawings. Calculations and drawings must be stamped and signed by a registered professional engineer. The design calculations shall include all code required load combinations that incorporate each of the following load cases:

a. Roof and Wall Wind Loads with basic wind speed, exposure category, co-efficient, risk category, designate type of facility, positive and negative pressures for each zone, methods and requirements of attachment.

b. Roof Dead and Live Loads

c. Collateral Loads

d. Foundation Loads

e. Seismic Loads

1.6.3 Qualification of Erection Contractor

An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and must be approved and certified by the metal building system manufacturer.

1.6.4 Single Source

Obtain primary and secondary components and structural framing members, each type of metal roof, wall and liner panel assemblies, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.6.5 Welding

Qualify procedures and personnel according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M.

1.6.6 Structural Steel

Comply with AISC 325, AISC 341 for seismic impacted designs, AISC 360, for design requirements and allowable stresses.

1.6.7 Cold-Formed Steel

Comply with AISC/AISI 121 and AISI SG03-3 for design requirements and allowable stresses.

1.6.8 Fabrication

Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles with dimensional and structural requirements

Provide metal panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Aluminum and aluminum-alloy sheet and plate must conform to ASTM B209.

Fabricate metal panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal building system manufacturer for application, but not less than thickness of metal being secured.

1.6.9 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.7 SHIPPING, HANDLING AND STORAGE

1.7.1 Delivery

Package and deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed and protected during transportation and handling.

Stack and store metal panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Store in a manner to prevent bending, warping, twisting, and surface damage. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage. Retain strippable protective covering on metal panel for entire period up to metal panel installation.

Protect foam-plastic insulation as follows:

a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

b. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to project site before installation time.

Complete installation and concealment of plastic materials as rapidly as possible in each area of construction to minimize ultraviolet exposure.

1.8 PROJECT CONDITIONS

1.8.1 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing panel system or building.

1.8.2 Field Measurements

1.8.2.1 Established Dimensions for Foundations

Comply with established dimensions on approved anchor-bolt plans, established foundation dimensions, and proceed with fabricating structural framing. Do not proceed without verifying field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.8.2.2 Established Dimensions for Metal Panels

Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8.2.3 Verification Record

Verify locations of all framing and opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in section on CAST-IN-PLACE CONCRETE.

Coordinate installation of equipment supports, piping and supports and accessories, which are specified in Division 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).

Coordinate installation of equipment supports and roof penetrations, which are specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.10 WARRANTY

1.10.1 Building System Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal building system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government. The warranty must provide that if within the warranty period, the metal building system shows evidence of deterioration resulting from defective materials and/or workmanship, correcting of any defects is the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal building system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs

performed by others and will not void the warranty.

1.10.2 Roof System Weather-Tightness Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the roof panel system shows evidence of corrosion, perforation, rupture, lost of weather-tightness or excess weathering due to deterioration of the panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Repairs that become necessary because of defective materials and workmanship while roof panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform temporary repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty. Immediate follow-up and completion of permanent repairs must be performed within 7 days from date of notification.

1.10.3 Roof and Wall Panel Finish Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 10 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the metal panel system shows evidence of checking, delaminating cracking, peeling, chalk in excess of a numerical rating of eight, as determined by ASTM D4214 test procedures; or change colors in excess of five CIE or Hunter units in accordance with ASTM D2244 or excess weathering due to deterioration of the panel system resulting from defective materials and finish or correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Liability under this warranty is exclusively limited to replacing the defective coated materials.

Repairs that become necessary because of defective materials and workmanship while roof and wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 STRUCTURAL FRAMING MATERIALS

2.1.1 W-Shapes

ASTM A992/A992M; ASTM A572/A572M or ASTM A529/A529M.

2.1.2 Channel, Angles, M-Shapes and S-Shapes

ASTM A36/A36M; ASTM A572/A572M or ASTM A529/A529M.

2.1.3 Plate and Bar

ASTM A36/A36M, ASTM A572/A572M or ASTM A529/A529M.

2.1.4 Steel Pipe

ASTM A36/A36M, ASTM A53/A53M, ASTM A572/A572M or ASTM A529/A529M.

2.1.5 Cold-Formed and Hot Formed Hollow Structural Sections

Cold formed:ASTM A500/A500M or ASTM B221, ASTM B221M. Hot-formed: ASTM A501/A501M.

2.1.6 Structural-Steel Sheet

Hot-rolled, ASTM A1011/A1011M or cold-rolled, ASTM A1008/A1008M.

2.1.7 Metallic-Coated Steel Sheet

ASTM A653/A653M, ASTM A606/A606M.

2.1.8 Metallic-Coated Steel Sheet Pre-painted with Coil Stock Coating

Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755/A755M.

a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, and ASTM A123/A123M.

2.1.9 High-Strength Bolts, Nuts, and Washers

ASTM A325M, heavy hex steel structural bolts; ASTM A563M heavy hex carbon-steel nuts; and ASTM F436M hardened carbon-steel washers.

Finish: Hot-dip zinc coating, ASTM A153/A153M.

Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, heavy-hex-head steel structural bolts with spline.

Finish: Mechanically deposited zinc coating, ASTM B695.

2.1.10 Non-High-Strength Bolts, Nuts, and Washers

ASTM A307, ASTM A563M, and ASTM F844.

Finish: ASTM A153/A153M.

2.1.11 Anchor Rods

ASTM F1554.

a. Configuration: Straight.

b. Nuts: ASTM A563M heavy hex carbon steel.

c. Plate Washers: ASTM A36/A36M carbon steel.

d. Washers: ASTM F436 hardened carbon steel.

e. Finish: Hot-dip zinc coating, ASTM A153/A153M.

2.1.12 Threaded Rods

ASTM A193/A193M, ASTM A572/A572M, or ASTM A36/A36M.

a. Nuts: ASTM A563M heavy hex carbon steel.

b. Washers: ASTM F436 hardened carbon steel.

c. Finish: Hot-dip zinc coating, ASTM A153/A153M.

2.1.13 Primer

SSPC-Paint 15, Type I, red oxide.

2.2 FABRICATION

2.2.1 General

Comply with MBMA MBSM - "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

2.3 STRUCTURAL FRAMING

2.3.1 General

Clean all framing members to remove loose rust and mill scale. Provide 1 shop coat of primer to an average dry film thickness of 1 mil according to SSPC SP 2. Balance of painting and coating procedures must conform to SSPC Paint 15 and SSPC Painting Manual.

2.3.2 Primary Framing

Manufacturer's standard structural primary framing system includes transverse and lean-to frames; rafter, rakes, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing designed to withstand required loads and specified requirements. Provide frames with attachment plates, bearing plates, and splice members. Provide frame span and spacing indicated.

Shop fabricate framing components by welding or by using high-strength bolts to the indicated size and section with base-plates, bearing plates, stiffeners, and other items required. Cut, form, punch, drill, and weld framing for bolted field erection.

a. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.

c. Frame Configuration: Two directional slope roofs with double end gables and an attached lean to structure.

d. Exterior Column Type: Uniform depth or Tapered.

e. Rafter Type: Uniform depth or Tapered.

2.3.3 Secondary Framing

Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated.

Shop fabricate framing components by roll-forming or break-forming to the indicated size and section with base-plates, bearing plates, stiffeners, and other plates required for erection. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

a. Purlins: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; minimum depth as indicated to comply with system performance requirements.

b. Girts: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange minimum depth as required to comply with system performance requirements.

c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.

d. Flange Bracing: Structural-steel angles or cold-formed structural tubing to stiffen primary frame flanges.

e. Sag Bracing: Structural-steel angles.

f. Base or Sill Angles: Zinc-coated (galvanized) steel sheet.

g. Purlin and Girt Clips: Steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.

h. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from structural-steel sheet.

i. Framing for Openings: Channel shapes; fabricated cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.

j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

2.3.4 Bracing

Provide adjustable wind bracing as follows:

a. Rods: ASTM A36/A36M; ASTM A572/A572M; or ASTM A529/A529M threaded full length at each end.

b. Cable: ASTM A475, diameter as required for project performance,

extra-high-strength grade, zinc-coated, stranded steel; with threaded end anchors.

c. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.

d. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

e. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

f. Bracing: Provide wind bracing using any method specified above, at manufacturer's option. All columns shall be pinned-base.

2.4 PANEL MATERIALS

2.4.1 Steel Sheet

Roll-form steel roof wall panels to the specified profile, with fy = 348 MPa and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Galvanized Steel Sheet conforming to ASTM A653/A653M and AISI SG03-3.

b. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A792/A792M and AISI SG03-3.

c. Individual panels to have continuous length to cover the entire length of any unbroken roof slope wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

d. Provide roof standing seam profile as shown on drawings.

2.4.2 Finish

All panels are to receive a factory-applied polyvinylidene fluoride finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. This prime coat must be oven cured prior to application of finish coat.

c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). This finish coat must be oven-cured.

d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. The wash-coat must be oven-cured.

e. Color: The exterior finish chosen from the manufacturer's color charts and chips to match FS 20400 Tan color.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

Chalking: ASTM DEFONLINE

Color Change and Conformity: ASTM D2244

Weatherometer: ASTM G152, ASTM G153 and ASTM D822

Humidity: ASTM D2247 and ASTM D714

Salt Spray: ASTM B117

Chemical Pollution: ASTM D1308

Gloss at 60 degrees: ASTM D523

Pencil Hardness: ASTM D3363

Reverse Impact: ASTM D2794

Flexibility: ASTM D522/D522M

Abrasion: ASTM D968

Flame Spread: ASTM E84

2.4.3 Repair Of Finish Protection

Repair paint for color finish enameled metal panel must be compatible paint of the same formula and color as the specified finish furnished by the metal panel manufacturer, conforming to ASTM A780/A780M.

2.5 MISCELLANEOUS METAL FRAMING

2.5.1 General

Cold-formed metallic-coated steel sheet conforming to ASTM A653/A653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.5.2 Fasteners for Miscellaneous Metal Framing

Refer to the following paragraph "FASTENERS".

2.6 FASTENERS

2.6.1 General

Type, material, corrosion resistance, size and sufficient length to

penetrate the supporting member a minimum of 25.4 mm with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE 7 requirements.

2.6.2 Exposed Fasteners

Fasteners for metal panels to be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately .09 mm thick.

2.6.3 Screws

Screws to be corrosion resistant coated steel, aluminum and/or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.6.4 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.7 FRAMES AND MATERIALS FOR OPENINGS

2.7.1 Doors

Fire-Rated and Non-Fire-Rated Door Assemblies conforming with NFPA 80 and based on testing according to NFPA 252 as specified in Division 08 - OPENINGS unless otherwise indicated.

2.8 ACCESSORIES

2.8.1 General

All accessories to be compatible with the metal panels; sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the metal panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips to be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.8.2 Roof and Wall Accessories and Specialties

Aluminum roof curbs, equipment supports, roof hatches, dropout-type heat and smoke vents, hatch-type heat and smoke vents, gravity and roof ridge ventilators, wall louvers and other miscellaneous roof and wall equipment or penetrations conforming to AAMA, ASTM, and UL as specified in Division 07 unless otherwise indicated.

2.8.3 Insulation

Faced, Glass-Fiber Blanket Insulation: ASTM C665, Type II, blankets with non-reflecting coverings; Class A, membrane-faced surface with a flame

spread of 25 or less, except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

2.8.3.1 Wall Liner

Securely fasten wall liner into place in accordance with the manufacturer's recommendation and in a neatly presented appearance.

2.8.4 Rubber Closure Strips

Closed-cell, expanded cellular rubber conforming to ASTM D1056 and ASTM D1667; extruded or molded to the configuration of the specified metal panel and in lengths supplied by the metal panel manufacturer.

2.8.5 Metal Closure Strips

Factory fabricated steel closure strips to be the same gauge, color, finish and profile of the specified roof wall panel.

2.8.6 Joint Sealants

2.8.6.1 Sealants

Sealants are to be an approved gun type for use in hand or air-pressure caulking guns at temperatures above 4 degrees C(or frost-free application at temperatures above minus 12 degrees C with minimum solid content of 85 percent of the total volume. Sealant is to dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the metal panel manufacturer.

2.8.6.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.8.6.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C920, Type II. Color to match panel colors.

2.8.6.4 Tape Sealant

Pressure sensitive, 100 percent solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the metal panel manufacturer.

2.9 SHEET METAL FLASHING AND TRIM

2.9.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.10 FINISHES

2.10.1 General

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

2.10.2 Appearance of Finished Work

Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10.3 Sunshades Type A & B

a. Sunshade Type A – Hotel Station locations

(1) Pre-engineered six column freestanding sunshade system, with curved steel roof framing and curved corrugated metal roof system as indicated on drawings. Color to be selected from the manufacturer’s standard color charts.

(2) Coordinate the dimensions of the sunshade with purchased equipment and required clearances.

b. Sunshade Type B - Transformer and Generator locations

(1) Pre-engineered four column free standing sunshade system, with curved steel roof framing and curved corrugated metal roof systemas indicated on drawings. Color to be selected from the manufacturer’s standard color charts.

(2) ordinate the dimensions of the sunshade with purchased equipment and required clearances.

c. Sunshade Type C - Transformer locations (each covering two transformers)

(1) Pre-engineered six column freestanding sunshade system, with curved steel roof framing and curved corrugated metal roof system as indicated on drawings. Color to be selected from the manufacturer's standard color charts.

(2) Coordinate the dimensions of the sunshade with purchased equipment

and required clearances.

PART 3 EXECUTION

3.1 EXAMINATION

Before erection proceeds examine with the erector present the concrete foundation dimensions, concrete and/or masonry bearing surfaces, anchor bolt size and placement, survey slab elevation, locations of bearing plates, and other embedment's to receive structural framing with the metal building manufacturer's templates and drawings before erecting any steel components for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Examine primary and secondary framing to verify that rafters, purlins, angles, channels, and other structural and metal panel support members and anchorages have been installed within alignment tolerances required by metal building manufacturer, UL, ASTM, ASCE 7 and as required by the building code for the geographical area where construction will take place.

Examine roughing-in for components and systems penetrating metal roof or wall panels to verify actual locations of penetrations relative to seam locations of metal panels before metal roof or wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Erector, listing conditions detrimental to performance of the Work.

Proceed with erection only after unsatisfactory conditions have been corrected.

Allow manufacturer's inspection after installation of structural framing, roof panel and wall panels to validate the manufacturer's warranty. Also allow the installer, certified by the manufacturer, to submit report to contracting officer after all installation is completed and all deficiencies may be found out during the course of installation is rectified.

3.2 PREPARATION

Provide temporary shoring, guys, braces, and other supports during erection to keep the structural framing secure, plumb, and in alignment against temporary construction loading or loads equal in intensity of the building design loads. Remove temporary support systems when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment and performance.

Miscellaneous Framing: Install sub-purlins, girts, angles, furring, and other miscellaneous support members or anchorage for the metal roof or wall panels, doors, windows, roof curbs, ventilators and louvers according to metal building manufacturer's written instructions.

3.3 ERECTION OF STRUCTURAL FRAMING

Erect metal building system according to manufacturer's written erection instructions, approved shop drawings and other erection documents in

accordance with MBMA MBSM - "Metal Building Systems Manual".

Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer and the Contracting Officer.

Set structural framing accurately in locations and to elevations indicated and according to AISC 325 specifications. Maintain structural stability of frame during erection.

Clean and roughen concrete and masonry bearing surfaces prior to setting plates. Clean bottom surface of plates.

Align and adjust structural framing before permanent bolt-up and connections. Perform necessary adjustments and alignment to compensate for changes or discrepancies in elevations.

Maintain erection tolerances of structural framing in accordance with AISC 360.

3.4 METAL WALL PANEL INSTALLATION

Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure. Any field modification or cutting that deviates from manufacturer's installation drawings, will require approval from the design engineer or manufacturer.

Field cutting metal wall panels by torch is not permitted.

3.5 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place in accordance with NRCA RoofMan and MBMA MBSM.

Erect roofing system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake and eave overhang.

Work must allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Field cutting metal roof panels by torch is not permitted. Any field modification or cutting that deviates from manufacturer's installation drawings, will require approval from the design engineer or manufacturer.

Roofing sheets must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 203.2 mm; the side laps of standard exterior corrugated sheets must not be not less than 2-1/2 corrugations.

Do not permit storage, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of roof construction.

3.6 METAL PANEL FASTENER INSTALLATION

Anchor metal panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.7 FLASHING, TRIM AND CLOSURE INSTALLATION

a. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

b. Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.8 DOOR AND FRAME INSTALLATION

Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each door frame with elastomeric sealant compatible with metal panels. Comply with installation requirements in Division 08 - OPENINGS.

3.9 ACCESSORY INSTALLATION

3.9.1 General

Install accessories with positive anchorage to building and weather-tight

mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

3.9.2 Dissimilar Metals

Where dissimilar metals contact one another or corrosive substrates are present, protect against galvanic action by painting dissimilar metal surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each surface, or by other permanent separation techniques as recommended by the metal building manufacturer.

3.9.3 Gutters and Downspouts

Comply with performance requirements, manufacturer's written installation instructions, and install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA 1793 recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.9.4 Insulation

Comply with performance requirements and manufacturer's written installation instructions. Install insulation concurrently with metal panel installation, in thickness indicated to cover entire roof and wall area, as specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

3.9.5 Roof and Wall Accessories and Specialties

Install roof and wall accessories and specialties complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports as specified in Division 07 - THERMAL AND MOISTURE PROTECTION, unless otherwise indicated.

3.10 CLEAN-UP AND PROTECTION

3.10.1 Structural Framing

Clean all exposed structural framing at completion of installation. Remove metal shavings, filings, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.10.2 Metal Panels

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove protective coverings/films, grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.10.3 Touch-Up Painting

After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories. Clean and touch-up paint with manufacturer's

touch-up paint.

3.11 WASTE MANAGEMENT

Separate waste in accordance with the Waste Management Plan, placing copper materials, ferrous materials, and galvanized sheet metal in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

Collect and place scrap/waste debris in containers. Promptly dispose of scrap/waste debris. Do not allow scrap/waste debris to accumulate on-site; transport scrap/waste debris from government property and legally dispose of them.

3.12 WARRANTY

3.12.1 MANUFACTURER'S WARRANTY

Submit all manufacturers' signed warranties to Contracting Officer prior to final commissioning and acceptance.

3.12.2 CONTRACTOR'S WARRANTY for INSTALLATION

Submit contractor's warranty for installation to the Contracting Officer prior to final commissioning and acceptance.

-- End of Section --

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SECTION 13 48 00

SEISMIC BRACING FOR MISCELLANEOUS EQUIPMENT
05/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 355.2	(2007) Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
ACI 355.4	(2011) Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4) and Commentary

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2011) Steel Construction Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A449	(2014) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A500/A500M	(2018) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,

	Welded and Seamless
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	(2018) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A603	(1998; R 2014) Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A653/A653M	(2018) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ICC EVALUATION SERVICE, INC. (ICC-ES)	
ICC ES AC156	(2012) Acceptable Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components
ICC-ES AC23	(2012; R 2016) Acceptance Criteria for Sprayed Fire-resistant Materials (SFRMs), Intumescent Fire-resistant Coatings and Mastic Fire-resistant Coatings Used to Protect Structural Steel Members
METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)	
MFMA-4	(2004) Metal Framing Standards Publication
U.S. DEPARTMENT OF DEFENSE (DOD)	
UFC 3-310-04	(2013; with Change 1, 2016) Seismic Design of Buildings
VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)	
VISCMA 412	(2014) Installing Seismic Restraints for Mechanical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for seismic protection measures, described in this section and on the drawings, of the miscellaneous equipment and systems listed below, in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Provide seismic protection measures

in addition to any other requirements called for in other sections of these specifications. Where there is a conflict between the specifications and the drawings, the specifications will take precedence. Accomplish resistance to lateral forces induced by earthquakes without consideration of friction resulting from gravity loads.

1.2.2 Miscellaneous Equipment and Systems

Provide bracing and attachment for all architectural, mechanical, and electrical equipment, components, and systems inside or attached to the Storage for Utility Services Building developed by the Contractor in accordance with the requirements of this specification. The Consolidated Utility Building addition is exempt from the requirements of this specification.

The following Equipment/Components/Systems with Ip = 1.5 are considered Designated Seismic Systems:

Fire Alarm
Emergency Lighting

1.2.3 Contractor Designed Bracing

Submit copies of the design calculations with the drawings. Calculations must be approved, certified, stamped and signed by a registered Professional Engineer. Calculations must verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Design the bracing in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes must be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas must be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 Specifications must be used for the design. The bracing for the equipment designated in paragraph 1.2.2 must be developed by the Contractor.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. When shown in this specification, detailed shop drawings for all required equipment, piping and ductwork with calculations certified by a registered engineer will be provided. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing; G M/R

Resilient Vibration Isolation Devices; G M

Equipment Requirements; G M

SD-03 Product Data

Bracing

Equipment Requirements

Anchor Bolts

Vibration Isolators

Snubbers

SD-05 Design Data

Design Calculations; G M

SD-06 Test Reports

Anchor Bolts; G M

SD-07 Certificates

ICC ES AC156 Shake Table Test

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Submit detail drawings of bracing along with calculations, catalog cuts, templates, and erection and installation details. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. Drawings must include enough information to clearly communicate the bracing design for all equipment, components, and systems. At a minimum, provide the equipment and bracing layout, indication of all Designated Seismic systems, and details for each type of bracing, including specific anchoring details to the supporting structure. Provide calculations and drawings that are stamped by a registered engineer, and that verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design must be based on actual equipment and system layout. Design must include calculated dead loads, static seismic loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods.

Include drawing for Designated Seismic System Equipment indicating the equipment location in the facility sufficient to be used for the installation. Equipment must be rigidly or flexibly mounted as indicated in the specifications and/or drawings depending on vibration isolation requirements as follows below. Roof mounted equipment both vibration isolated and nonisolated, must have support members designed and anchored to building structural steel or concrete as required for seismic restraint and wind loads.

2.1.1 Rigidly (Base and Suspended) Mounted Equipment

Equipment furnished under this contract must be rigidly mounted using cast-in-place anchor bolts to anchor them or post-installed anchors that are qualified for earthquake loading in accordance with ACI 355.2 and

ACI 355.4. Anchor bolts must conform to ASTM F1554-07ae1. For any rigid equipment which is rigidly anchored, provide flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions. Suspended equipment bracing attachments should be located just above the center of gravity to minimize swinging. Designated Seismic Systems (DSS) must have two nuts provided on each anchor bolt.

2.1.2 Nonrigid or Flexibly-Mounted Equipment

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 6 mm . Equipment flexibly mounted on vibration isolators must have a bumper restraint or snubber in each horizontal direction and vertical restraints must be provided where require to resist overturning. Isolator housing and restraints must be constructed of ductile materials. A viscoelastic pad or similar material of appropriate thickness must be used between the bumper and components to limit the impact load. Restraints must be designed to resist the calculated horizontal lateral and vertical forces.

Spring vibration isolators must be seismically rated, restrained isolators for equipment subject to load variations and large external forces. The seismically rated housing must be sized to meet or exceed the force requirements applicable to the project and meet the required isolation criteria. Spring vibration isolator manufacturer's will be a member of VISCMA. Design force, Fp, must be doubled for vibration isolators with an air gap greater than 0.25 inches as specified in ASCE 7, Chapter 13.

2.2 BOLTS AND NUTS

Hex head bolts, and heavy hexagon nuts must be ASTM A307 Grade A bolts or ASTM A449 high strength bolts and ASTM A563 nuts. Provide bolts and nuts galvanized in accordance with ASTM A153/A153M when used underground and/or exposed to weather.

2.3 SWAY BRACING

Material used for members listed in this section and on the drawings, must be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A36/A36M or ASTM A572/A572M, Grade 50.

b. Wire rope, ASTM A603.

c. Tubes, ASTM A500/A500M, Grade B.

d. Pipes, ASTM A53/A53M, Type E, Grade B.

e. Light gauge angles, less than 6 mm thickness, ASTM A653/A653M.

f. Channels (Strut) with in-turned lips and associated hardware for fastening to channels at random points conforming to MFMA-4.

PART 3 EXECUTION

3.1 BRACING

Provide bracing conforming to the arrangements shown. Install cables at a

45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 412.

3.2 BUILDING DRIFT

Do not attach sway braces for equipment to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Bracing must be capable of accommodating building drift due to seismic displacements.

3.3 ANCHOR BOLTS

3.3.1 General

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified.

Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices allowing adequate edge distance and embedment depth for restraint anchor bolts. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Install neoprene grommet washers or till the gap with epoxy on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 0.125 inches.

3.3.2 Cast-In-Place

Use templates to locate cast-in-place bolts accurately and securely in formwork. Provide anchor bolts with an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads must either extend into concrete floor or the foundation or be increased in depth to accommodate bolt lengths. Use templates to locate cast-in-place bolts accurately and securely in formwork.

3.3.3 Drilled-In Anchor Bolts

Drill holes with rotary impact hammer drills. Drill bits must be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the drawings, all holes must be drilled perpendicular to the concrete surface. Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Contracting Officer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines. Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Perform anchor installation in accordance with manufacturer instructions. For Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10 percent of the specified torque, 100 percent of the specified torque must be reached within 7 or fewer complete turns of

the nut. If the specified torque is not achieved within the required number of turns, the anchor must be removed and replaced unless otherwise directed by the Engineer.

For Cartridge Injection Adhesive Anchors where approved for seismic application, clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive must be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed. For Capsule Anchors where approved for seismic application, perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors must be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.3.4 Anchor Bolt Testing

Test in place expansion and chemically bonded anchors not more than 24 hours after installation of the anchor, conducted by an independent testing agency; testing must be performed on random anchor bolts as described below.

3.3.4.1 Torque Wrench Testing

Perform torque wrench testing on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque must equal the minimum required installation torque as required by the bolt manufacturer. Calibrate torque wrenches at the beginning of each day the torque tests are performed. Recalibrate torque wrenches for each bolt diameter whenever tests are run on bolts of various diameters. Apply torque between 20 and 100 percent of wrench capacity. Reach the test torque within one half turn of the nut, except for 9 mm sleeve anchors which must reach their torque by one quarter turn of the nut. If any anchor fails the test, test similar anchors not previously tested until 20 consecutive anchors pass. Failed anchors must be retightened and retested to the specified torque; if the anchor still fails the test it must be replaced.

3.3.4.2 Pullout Testing

Test expansion and chemically bonded anchors by applying a pullout load using a hydraulic ram attached to the anchor bolt. Testing must be done in accordance with ASTM E488/E488M or ICC-ES AC23. At least 5 percent of the anchors, but not less than 3 per day must be tested. Apply the load to the anchor without removing the nut; when that is not possible, the nut must be removed and a threaded coupler must be installed of the same tightness as the original nut. Check the test setup to verify that the anchor is not restrained from withdrawing by the baseplate, the test

fixture, or any other fixtures. The support for the testing apparatus must be at least 1.5 times the embedment length away from the bolt being tested. Load each tested anchor to 1 times the design tension value for the anchor. The anchor must have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested must be tested until 10 consecutive anchors pass. Failed anchors must be retightened and retested to the specified load; if the anchor still fails the test it must be replaced.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, select anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations that follow the same procedure as in paragraph ANCHOR BOLTS, except use an equipment weight equal to five times the actual equipment weight.

3.4.1 Spring-Type Vibration Devices

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 13 mm. Equipment flexibly mounted on vibration isolators must have a bumper restraint or snubber in each horizontal direction and vertical restraints must be provided where required to resist overturning. Isolator housing and restraints must be constructed of ductile materials. A viscoelastic pad or similar material of appropriate thickness must be used between the bumper and components to limit the impact load. Restraints must be designed to resist the calculated horizontal lateral and vertical forces.

Spring vibration isolators must be seismically rated, restrained isolators for equipment subject to load variations and large external forces. The seismically rated housing must be sized to meet or exceed the force requirements applicable to the project and meet the required isolation criteria. Spring vibration isolator manufacturers will be a member of VISCMA.

3.4.2 Multidirectional Seismic Snubbers

Install multidirectional seismic snubbers employing elastomeric pads on floor- or slab-mounted equipment. Use snubbers that provide 6 mm free vertical and horizontal movement from the static deflection point. Provide snubber medium consisting of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.5 EQUIPMENT SWAY BRACING

3.5.1 Suspended Equipment

Provide equipment sway bracing for items supported from floor, overhead floor or roof structural systems. Provide braces that consist of angles, rods, wire rope, bars, channels (struts) or pipes arranged as shown in bracing submittals and secured at both ends with not less than 13 mm bolts. Provide sufficient braces for equipment to resist a horizontal force as specified in UFC 3-310-04 without exceeding safe working stress of bracing components. Provide, for approval, specific force calculations in accordance with UFC 3-310-04 for the equipment in the project. Submit details of equipment bracing for acceptance. In lieu of bracing with

vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.5.2 Floor or Pad Mounted Equipment

3.5.2.1 Shear Resistance

Bolt to the floor, floor mounted equipment. Provide the number and installation of bolts to resist shear forces in accordance with paragraph ANCHOR BOLTS.

3.5.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and overturning.

3.6 SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT

Equipment and components designated as Designated Seismic Systems required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-310-04, Section 4-13.2.2.1 Component Qualification Documentation.

Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches x 7 inches with red letters 1 inch in height on a white background stating "Certified Equipment." The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file." The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

-- End of Section --

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SECTION 21 13 13.00 20

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2016; TIA 16-1; TIA 16-2; TIA 16-3 2016; Errata 17-1; Errata 17-2) Standard for the Installation of Sprinkler Systems
NFPA 24	(2016; ERTA 2016) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Design and provide new and modify existing automatic wet pipe fire extinguishing sprinkler systems for complete fire protection coverage throughout Consolidated Utility Building Addition.

1.3 SPRINKLER SYSTEM DESIGN

Except as modified herein, design automatic wet pipe fire extinguishing sprinkler systems in accordance with the required and advisory provisions of NFPA 13, including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standard(s), as though the word "shall" had been substituted for the word "should" wherever it appears. Design system by hydraulic calculations for uniform distribution of water over the design area. Hydraulic calculations shall assume a 55 kPa pressure loss for the backflow preventer assembly. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Provide sprinklers and piping system layout. All Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM APP GUIDE approved for use in wet pipe sprinkler systems. Provide seismic protection for the sprinkler system. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes."

1.3.1 Location of Sprinklers

Sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13 for ordinary hazard occupancy. Uniformly space sprinklers on the branch piping. Sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces.

1.3.2 Water Distribution

Distribution shall be uniform throughout the area in which the sprinklers will open. Discharge from individual sprinklers in hydraulically most remote area shall be between 100 percent and 120 percent of the specified density.

1.3.3 Density of Application of Water

Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be 8.2 L/m per sq meter for Ordinary Hazard Group 1 Occupancies.

1.3.4 Sprinkler Discharge Area

Area shall be the hydraulically most remote 330 sq meter Area reductions and increases from NFPA 13 shall not be applied to this area.

1.3.5 Outside Hose Allowances

Hydraulic calculations shall include a hose allowance of 950 L/m for outside hose streams.

1.3.6 Water Supply

Base hydraulic calculations on a static pressure of 552 kPa (gage) with 3,860 L/m available at a residual pressure of 427 kPa (gage) at the base of the sprinkler piping riser.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.

Partial submittals and submittals not fully complying with the requirements and recommended practices of NFPA 13 and this specification section shall be returned disapproved without review. This contract stipulation is non-negotiable.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G M

Prepare A1 841 by 594 mm detail working drawings of sprinklers and piping. Floor plans shall be drawn to a scale not less than 1:100. Show data essential for proper installation of each system. Show details, plan view, elevations and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe and fittings. Show point to point electrical wiring diagrams. Submit drawings signed by a registered fire protection engineer. Provide one copy of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation.

SD-03 Product Data

Pipe

Fittings

Valves, including gate, check, and globe

Sprinklers

Pipe hangers and supports

Mechanical couplings

Seismic Bracing

Annotate descriptive data to show the specific model, type, and size of each item. Catalog cuts shall also indicate UL Listing/FM Approval and country of manufacture.

SD-05 Design Data

Hydraulic Calculations; G M

Submit computer program generated hydraulic calculations to substantiate compliance with hydraulic design requirements. Calculations shall be performed by computer using software intended specifically for fire protection system design. Calculations shall include isometric diagram indicating hydraulic nodes and pipe segments. Submit name of software program used.

SD-06 Test Reports

request to schedule Preliminary Tests; G M

Preliminary Test Report; G M

Provide one copy of the completed Preliminary Test Report, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Engineer.

request to schedule Final Acceptance Test; G M

Final Acceptance Test Report; G M

Provide one copy of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Engineer.

SD-07 Certificates

Inspection by Fire Protection Engineer

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Engineer that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

Fire Protection Engineer

The name and documentation of certification of the proposed Fire Protection Engineer, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer

Submit data showing the Sprinkler System Installer has successfully installed systems of the same type and design as specified herein, Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months. Provide NICET certification of the system technician. Contractor shall submit data along with submittal of the Fire Protection Engineer Qualifications.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G R

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modifies by this specification section.

Provide 2 manuals in accordance with NFPA 13. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

SD-11 Closeout Submittals

As-built drawings; G M/R

As-built shop drawings, at no later than 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is

completed. Provide electronic drawings in dwg or pdf format.

On-site training; G M/R

1.5 QUALIFICATIONS

1.5.1 Fire Protection Engineer

A Fire Protection Engineer is a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES).

1.5.2 Sprinkler System Installer

The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of, a system technician who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level III certification in Automatic Sprinkler System program or by a fire protection engineer. The Sprinkler System Installer shall be on the site each day sprinkler installation is in progress.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.6.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.6.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.7 DELIVERY, STORAGE AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

PART 2 PRODUCTS

2.1 ABOVEGROUND PIPING COMPONENTS

All components of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section. Aboveground piping shall be steel.

2.1.1 Steel Pipe

Pipe shall be black steel. Steel piping shall be Schedule 40. Fittings into which sprinklers, sprinkler riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 40 mm and larger. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Side outlet tees using rubber gasketed fittings shall not be permitted. Roll grooving of galvanized pipe is prohibited.

2.1.2 Grooved Mechanical Joints and Fittings

Grooved couplings, fittings and grooving tools shall be products of the same manufacturer.

2.1.3 Flexible Sprinkler Hose

The use of flexible sprinkler hose is not permited.

2.1.4 Sprinklers

Provide nominal 12.7 mm or 13.5 mm orifice sprinklers. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Sprinklers shall match existing sprinkler characteristics.

2.1.5 Valves

Provide valves of types approved for fire service. Valves shall open by counterclockwise rotation.

2.1.6 Pipe Supports

Provide Pipe hangers and supports and Seismic Bracing in accordance with NFPA 13.

PART 3 EXECUTION

3.1 INSPECTION BY FIRE PROTECTION ENGINEER

The Fire Protection Engineer shall inspect the sprinkler system at 50

percent completion and at completion of the installation to assure the sprinkler system is being provided and installed in accordance with the contract requirements and the approved sprinkler system submittal(s). The Fire Protection Engineer shall attend both the preliminary and final tests, and shall sign the test results. After the preliminary testing has been completed, the Fire Protection Engineer, shall certify in writing the system is ready for the final inspections and tests. This report shall document any discrepancies found and what actions will be taken to correct. Any discrepancy noted during the periodic site visits or the preliminary testing shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.2 UNDERGROUND PIPING INSTALLATION

The methods of fabrication and installation of the underground piping shall fully comply with the requirements and recommended practices of NFPA 13, NFPA 24 and the contract drawings.

3.3 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

3.3.1 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.3.2 Pendent Sprinklers

Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 25 mm below the underside of the ceiling. Pendent sprinklers in suspended ceilings shall be a minimum of150 mm from ceiling grids.

3.3.3 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. The diameter of grooves made in the field shall be measured using the method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances.

3.3.4 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. Bushings are prohibited.

3.3.5 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.3.6 Inspector's Test Connection

Provide test connections approximately 2 meters above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device. Provide test connection piping to a drain location that can accept full flow where the discharge will be readily visible and where water may be discharged without property damage. Discharge to floor drains, janitor sinks or similar fixtures shall not be permitted. Provide discharge orifice of same size as corresponding sprinkler orifice. The penetration of the exterior wall shall be no greater than 0.61 meter above finished grade.

3.4 PIPE PAINTING AND COLOR CODE MARKING

Paint and color code mark sprinkler piping system as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Submit request to schedule Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Upon completion of specified tests, the Contractor shall submit for approval a Preliminary Test Report.

3.5.1 Aboveground Piping

3.5.1.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13.

3.6 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. Submit request to schedule Final Acceptance Test, no later than 14 days prior to the proposed start of the tests. Notification shall include a copy of the Contractor's Material & Test Certificates.

This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. The Contractor shall submit the Final Acceptance Test Report as specified in the Submittals paragraph.

An experienced technician regularly employed by the system installer shall be present during the inspection. The Fire Protection Engineer shall attend the final inspections and tests. At this inspection, repeat any or all of the required tests as directed. Correct defects in work provided by the Contractor, and make additional tests until the systems comply with contract requirements. A Government Fire Protection Engineer, will witness formal tests and approve systems before they are accepted.

3.7 ON-SITE TRAINING

Submit request to schedule the On-site Training, at least 14 days prior to the start of related training but prior to the final inspections and tests. The sprinkler contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

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