Del City Water Treatment Plant
Flocculating Clarifier Mechanisms Replacement

Project Specifications

Pre-Purchase Equipment Supply

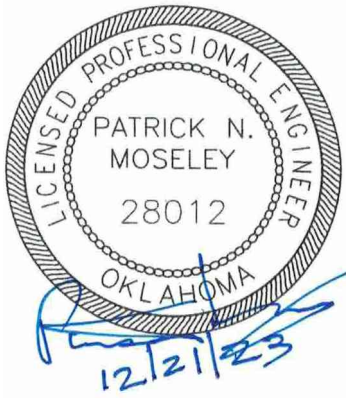
January 2024
Project #: 3298-001-01

Prepared by:
PLUMMER | 531 Couch Drive Suite 200 | Oklahoma City, Oklahoma 73102

PLUMMER

FLOCCULATING CLARIFIER MECHANISMS REPLACEMENT
CITY OF DEL CITY, OKLAHOMA

ENGINEERS' SEALS

Divisions: 01, 03, 05, 09, 46	Divisions: 40
	
Jason Laubacher, PE **Plummer Associates, Inc.** **Process/Civil**	**Patrick Moseley, PE** **Plummer Associates, Inc.** **Electrical/Instrumentation**

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SECTION 00 11 16
INVITATION TO BID

Sealed bids addressed to City Secretary, City of Del City, 3701 SE 15th Street, Del City, Oklahoma 73115 for:

Del City Water Treatment Plant
Flocculating Clarifier Mechanisms Replacement
Pre-Purchase Equipment Supply

will be received until 10 a.m. on Wednesday, January 31, 2024, at the City Secretary's Office, 3701 SE 15th Street, Del City, Oklahoma 73115, at which time and place the bids will be publicly opened and read aloud. Any bid received after the time set for opening bids will be returned unopened. Bids may be modified or withdrawn at any time prior to the time set for opening bids.

This project consists of equipment supply for the Del City Water Treatment Plant located in Del City, Oklahoma, including the following equipment item:

46 43 61 Flocculating Clarifier Equipment

Contract Documents may be examined at the following:

1. City of Del City
   City Secretary's Office
   3701 SE 15th Street
   Del City, Oklahoma 73115
   Telephone (405) 670-7321
   Attention: Diane League
2. Broadcast Demand Star

Plummer Associates, Inc. is utilizing Broadcast Demand Star (https://network.demandstar.com/) for distribution of all Contract Documents. Contract Documents, including addenda and plan holder's list can be viewed and downloaded free of charge to all interested parties. Electronic copies of the Plans, Specifications and Contract Documents on a USB Flash Drive may be obtained from the City of Del City address listed above upon payment of $5.

Bidders should direct questions regarding distribution of Contract Documents for this Project to Jason Laubacher, P.E. with Plummer Associates, Inc. (jlaubacher@plummer.com) or Jay Snapp with the City of Del City (jsnapp@cityofdelcity.org) prior to five (5) working days before the bid opening.

Equipment bidders who are not named in the specifications shall be prequalified to submit a proposal for this project by submitting a pre-bid submittal. Prebid submittals from bidders who are not named in the specifications shall be furnished to the ENGINEER in accordance with the specifications, no later than seven (7) days prior the date of the bid opening. Bid Submittal information and a detailed itemized quotation are required to be furnished with the Bid by all Bidders.

Bid shall be accompanied by either a Bid Bond from a surety satisfying the requirements specified below for the Performance Bond, Payment Bond and any other bonds set forth in the Contract Documents, or certified check upon a national or state bank in an amount not less than 5 percent (5%) of the total maximum bid price, payable without recourse to the City of Del City, Oklahoma as a guarantee that the

Bidder will within fifteen (15) days after Notice of Award enter into a Contract and furnish a Performance Bond, Payment Bond and any other bonds set forth in the Contract Documents upon the forms provided, each in the amount of 100 percent (100%) of the Contract price, from a surety licensed to conduct business in the state where the Project is located and named in the current list of "Surety Companies Acceptable on Federal Bonds" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department.

The surety shall have an "A" minimum rating of performance and a financial rating strength of five times the Contract price, all as stated in current "Best's Key Rating Guide, Property-Liability." Each Bond shall be accompanied by a "Power of Attorney" authorizing the attorney-in-fact to bind the surety, and shall be certified to include the date of the Bond.

The OWNER reserves the right to accept or reject any or all bids, to waive any formalities and technicalities, and to accept the bid, that at the OWNER'S sole discretion, is most advantageous to the OWNER.

The OWNER reserves the right, after evaluation of all bids received, to make no recommendation regarding the award of any bid in the event non-responsive, non-conforming, or otherwise unacceptable bids are received, or if budgetary constraints or other unanticipated factors exist. No bid may be withdrawn until the expiration of ninety (90) days from the date bids are opened.

OFFICIAL ADVERTISEMENT: CITY OF DEL CITY

First Pub: January 11, 2024

Mike Hatfield
Director of Public Works

END OF SECTION

SECTION 00 21 13
INSTRUCTIONS TO BIDDERS FOR EQUIPMENT SUPPLY

PART 1 - BIDDING PROCEDURE, SELECTION AND ASSIGNMENT OF EQUIPMENT

1.1 MANUFACTURING EXPERIENCE OF BIDDERS

A. No equipment shall be offered from any manufacturer not regularly engaged in the production of equipment of the size and type specified for a period of at least five (5) years. Experience requirements in the equipment specifications apply to U.S. installations comparable in size and type to those specified. Additional experience requirements are specified in Section 00 50 00 “Special Conditions”. Individual specifications may have more stringent requirements.

B. For an experience record to be considered acceptable, it must reflect the experience of the vendor seeking qualification of supplying equipment and/or material of the same nature as that of the project for which bids are to be received, and such experience must have been on projects completed not more than 15 years prior to the date on which bids are received.

1.2 PREBID SUBMITTALS AND QUALIFICATIONS OF BIDDERS

A. Prospective bidders who are not named in the Equipment Specifications shall be prequalified by submitting a proposal for this project as described in Paragraph 1.2 Prebid Submittals Requirements in Section 00 50 00 “Special Conditions”. An acceptable experience record, installation list, exceptions to and deviations requested from the contract documents, if any, and other information required by the Special Conditions must be received by the ENGINEER no later than the Prebid submittal date in the Invitation to Bid. Proposals submitted by a prospective bidder who has not fulfilled this requirement shall be returned unopened. Exceptions and deviations requested will be reviewed and at the ENGINEER’S discretion may be addressed by addendum. Items that are not changed by addendum shall be bid per the Specifications.

B. Examination of Bid Documents
   1. Prior to submission of a proposal, all bidders shall have made a thorough examination of the Bid Documents and shall become informed as to the nature of the work and all other matters that may affect the cost and time of completion of the work.

C. Interpretations
   1. All questions about the meaning or intent of the Bid Documents shall be submitted to the ENGINEER in writing. Replies will be issued by Addenda, utilizing Broadcast Demand Star. Questions received less than five working days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect. Addenda will become a part of the Contract Documents.

D. Time of Completion
   1. The time period for shop drawings submittal shall be 56 consecutive calendar days (8 weeks) following date of Notice to Proceed issued by the OWNER or by the ENGINEER for the OWNER or receipt of a purchase order from the CONTRACTOR (whichever occurs first).
   2. The time period for Equipment Delivery shall be 210 consecutive calendar days (30 weeks) beginning 5 days after the date the first submittal is returned to the SUPPLIER.

3. Provisions for liquidated damages are set forth in Section 00 50 00 “Special Conditions”.
4. The equipment items to be provided are, but not necessarily limited to, the following:

Section	Description
46 43 61	Flocculating Clarifier Equipment

E. Bid Form (Proposal)
1. Bidders may submit the Bid (Proposal) on copies of the forms included in the documents for each contract Bid. Specification books are not required to be submitted with the Bids. A copy of the Bid Submittal information required in Paragraph 1.3 of Section 00 50 00 “Special Conditions”, however, shall be included in the same sealed envelope with the Proposal.
2. Bid (Proposal) Forms must be completed in ink. The Bid price of each item on the form must be stated in words, if specifically requested, and/or numerals; in case of conflict, words shall take precedence.
3. Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign). The corporate address and state of incorporation shall be shown below the signature.
4. Bids by partnerships must be executed in the partnership name and signed by a partner, his title must appear under his signature and the official address of the partnership must be shown below the signature.
5. All names must be printed below the signature.
6. The Bid shall contain an acknowledgment of receipt of all Addenda (the dates of which shall be filled in on the Bid Form).
7. The Base Bid price as stated in the proposal shall be a lump sum price for fabricating, furnishing, testing, delivering (and installing if applicable), and starting up the equipment and materials, FOB destination, including all applicable taxes, and all costs for the items and services as hereinafter specified.

F. Submission of Bids
1. Bids shall be submitted only by named and prequalified bidders at the time and place indicated in the Invitation for Bids and shall be included in an opaque sealed envelope, marked on the outside with the Project title, name and address of the Bidder in proposal. Bid shall be accompanied by the Bid Security and other required documents. It shall be the Bidder's responsibility to deliver the proposal at the proper place by the time stated in the Invitation for Bids. The fact that a proposal was dispatched will not be considered.
2. Bidders shall include a detailed itemized quotation and the Bid Submittal information per Paragraph 1.3, Section 00 50 00 “Special Conditions”, with the Bid. Deviations or exceptions to the specifications, if any, shall be included, however, significant deviations or exceptions, in the opinion of the ENGINEER may be cause for rejection of the Bid at the sole discretion of the OWNER.
3. The detailed, itemized quotation shall be an itemized listing showing the quantity, size, capacity, description, electrical requirements, etc., of each component included in the Bid. This quotation is a summary for aiding the CONTRACTORS in identifying the

equipment being furnished for installation and shall not be a basis for compliance or noncompliance with the Specifications.

G. Modification and Withdrawal of Bids
   1. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids. Bids may not be withdrawn after opening of Bids for the period set forth in the Invitation for Bids.

H. Opening of Bids
   1. Bids will be opened as indicated in the Invitation for Bids. Bids received after such time will not be considered, and will be returned unopened.

I. Bids to Remain Open
   1. All bids shall remain open for the period of time set forth in the Invitation for Bids, but OWNER may, in his sole discretion, release any Bid and return the Bid Security prior to that date.

J. Ambiguity
   1. In case of ambiguity or lack of clearness in stating prices in the Bid, the OWNER reserves the right to adopt the most advantageous interpretation thereof to the OWNER or reject the Bid.

K. Bid Security
   1. Bids shall be accompanied by either a Bid Bond from a surety satisfying the requirements specified below or certified check upon a national or state bank in an amount not less than 5 percent (5%) of the total maximum bid price, payable without recourse to City of Del City as a guarantee that the bidder will execute an agreement with the OWNER, furnish a Performance Bond and a Payment Bond, and accept a purchase order from the successful construction contractor in accordance with the provisions of this document. The surety shall be licensed to conduct business in the State of Oklahoma and shall be named in the current list of "Surety Companies Acceptable on Federal Bonds" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U. S. Treasury Department. The surety shall have an "A" minimum rating of performance and a financial rating strength of five times the Contract Price, all as stated in current "Best's Key Rating Guide, Property-Liability". Each bond shall be accompanied by a "Power of Attorney" authorizing the attorney-in-fact to bind the surety, and shall be certified to include the date of the Bond.
   2. The bid security of the successful Bidder will be retained until he has executed the Agreement and furnished the required Contract Security, whereupon checks furnished as bid security will be returned; if he fails to execute and deliver the Agreement and furnish the required Contract Security within fifteen (15) days of request, OWNER may annul the Notice of Award and the bid security of that Bidder will be forfeited. The bid security of any Bidder whom OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the seventh day after the executed Agreement is delivered by OWNER to Bidder, and the required Contract Security is furnished but not to exceed 90 days after the Bid opening. Checks furnished as bid security by other Bidders will be returned within fifteen (15) days of the Bid opening. If a bidder has submitted a Bid, which upon opening has an obvious and substantial mistake, the Bidder may submit a request in writing within 48-hours of Bid Opening to withdraw the Bid, and for the OWNER to return the Bid security. The

OWNER reserves the right to determine whether or not the Bid security should be returned.

L. With the execution and delivery of the Contract, the Bidder shall execute and furnish Performance Bond on the form provided, as follows:

1. Performance Bond. A Performance Bond in the amount of 100 percent of the Contract price, or any increases or deletions therefrom due to contract modifications, guaranteeing faithful performance of the Work and fulfillment of the obligations of the Contract. The Performance Bond shall guarantee that the Bidder will repair or replace all defects in the Work arising from defective or inferior workmanship or materials used therein or performance guarantee for a period of twenty-four (24) months from the date of final acceptance of the Work by the OWNER.
2. Payment Bond. A Payment Bond in the amount of 100 percent of the Contract price, or any increases of deletions therefrom due to contract modifications, guaranteeing payment to all persons supplying labor and materials or furnishing equipment in the execution of the Contract.
3. Performance Bond and Payment Bond shall be from an approved surety company holding a permit from the State of Oklahoma to act as surety, and named in the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. The surety shall have an "A" minimum rating of performance and a financial rating strength of five times the Contract Price, all as stated in current "Best's Key Rating Guide, Property-Liability." Each Bond shall be accompanied by a "Power of Attorney" authorizing the attorney-in-fact to bind the surety, and shall be certified to include the date of the Bond.

M. Owner Selection of Equipment and Contract Execution

1. The OWNER reserves the right to reject any and all Bids on any or all items and waive any and all formalities or technicalities, and may disregard any non-conforming, non-responsive, or conditional Bids or Counterproposals, and to accept the bid, that at the OWNER'S sole discretion, is most advantageous to the OWNER. The OWNER may consider experience requirements, materials of construction, capacity or capability of equipment, operation and maintenance aspects, and other factors the OWNER determines as a factor in selecting the equipment.
2. The bid proposal for the selected equipment, along with Contract Award, and all information submitted as part of the proposal, and for prequalification shall become a part of these specifications and shall be included in the Contract Documents for installing the equipment. In the absence of exceptions, it shall be understood that the equipment to be supplied conforms in every respect to the Contract Documents.
3. It is the intention of the OWNER to notify the successful Bidder in writing (provide notice of award), within fifteen (15) days after receiving bids, of his acceptance of the Bid. The OWNER requires that the successful bidder begin preparation of shop drawings upon receipt of notification of acceptance of his bid and notification to begin shop drawing preparation. Shop drawings shall be submitted to the OWNER or ENGINEER within the time period specified in Paragraph 1.2.D.1 of this Section. Should the OWNER fail to execute a contract with a General CONTRACTOR, after notifying the supplier of acceptance of his bid and authorizing him to proceed with shop drawings, and after receipt of the shop drawings, the OWNER agrees to pay 5-percent (5%) of the price bid to the Bidder.

4. The accepted Bidder shall, within fifteen (15) days following formal Notice of Award, execute the formal Contract Agreement on the form provided by the OWNER and furnish performance and payment bonds.
5. Receipt of a purchase order from the CONTRACTOR or a Notice to Proceed from the OWNER, or ENGINEER for the OWNER, will be authorization for the Bidder to begin work. The execution of the Contract is NOT an authorization to begin work. Refer to Paragraph 1.4, Section 00 50 00 "Special Conditions" for additional information on Notice to Proceed and Purchase Order issuance.

N. Assignment of Equipment Contracts
1. The equipment Contracts and responsibility for purchasing and installing the selected equipment will be assigned to the successful general CONTRACTOR. The OWNER reserves the right to issue the Notice to Proceed for shop drawing preparation and separately for fabrication and delivery, prior to selecting the CONTRACTOR. If a CONTRACTOR is not selected, the OWNER will make payments to the SUPPLIER in accordance with the Special Conditions.
2. The CONTRACTOR shall assume all responsibility for issuing a Purchase Order for the amount of the Base Bid (with or without deduct as determined by the OWNER) for the selected equipment, paying for equipment, scheduling delivery, receiving and protecting the equipment, scheduling manufacturer's service representative as required, installing the equipment, and coordinating the performance testing of the equipment, all as if the CONTRACTOR had selected the equipment for the project.
3. The CONTRACTOR will be assigned the obligation to make payments directly to the Bidder for the equipment in accordance with the terms of payment as described herein, from money received by the CONTRACTOR from the OWNER in payment for materials and equipment. This assignment relieves the OWNER of any liability to pay the Bidder directly.
4. The construction contract is anticipated to meet the following schedule:

Description	Anticipated Advertisement	Anticipated Bid Opening	Anticipated Award
Construction of Del City Water Treatment Plant Clarifier Mechanism	January 2024	January 2024	February 2024

5. By executing the Contract Agreement with the OWNER, Bidder shall agree that the proposal is valid and unchanged as long as the Notice to Proceed or Purchase Order is issued prior to expiration of the time period specified in Section 00 11 16, "Invitation to Bid".

O. Terms of Agreement
1. Conditions of sale shall be in accordance with the requirements in these Contract Documents and not Bidder's standard conditions. Exceptions taken to these requirements may be cause for rejection of the bid.

END OF SECTION

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SECTION 00 41 13
BID PROPOSAL

Date _____, 2024

PROPOSAL OF _____,

a Corporation organized and existing under the laws of the State of_____, a partnership consisting of_____, the business name of_____, an individual.

TO: City Secretary
City of Del City
3701 SE 15th Street
Del City, Oklahoma 73115

PROPOSAL FOR: DEL CITY WATER TREATMENT PLANT
FLOCCULATING CLARIFIER MECHANISMS REPLACEMENT
PRE-PURCHASE EQUIPMENT SUPPLY

The undersigned, as Bidder, declares that the only person or parties interested in this proposal as principals are those named herein, that this proposal is made without collusion with any other person, firm, or corporation; that he has carefully examined the form of Contract, Invitation for Bids, Instructions to Bidders for Equipment Supply, the Special Conditions, and Specifications herein referred to, and has carefully examined the locations, conditions, and classes of materials of the proposed work; and agrees that he will provide all the necessary labor, machinery, tools, apparatus, and other items incidental to providing the specified equipment, and will do all the work and furnish all the materials as called for in these Documents in the manner prescribed and according to the Specification requirements of the OWNER as herein set forth.

Accompanying this proposal is a (certified or cashier's check payable to the Owner) (Bid Bond) in the amount of _____
_____ Dollars ($_____).

The bid security accompanying this Proposal shall be returned to the bidder, unless in case of the acceptance of the Proposal, the bidder shall fail to execute a Contract in accordance with the provisions of these documents within fifteen (15) days of receipt of the Notice of Award, in which case the bid security shall become the property of the OWNER, and shall be considered as payment for damages due to delay and other inconveniences suffered by the OWNER on account of such failure of the bidder. It is understood that the OWNER reserves the right to reject any and all bids received and waive any formalities and technicalities in any Bid.

Prices shall be shown in words and figures. In the event of discrepancy, the words shall govern.

Award of contracts by OWNER, if made, will be as described in the Section 00 21 13 “Instruction to Bidders for Equipment Supply”.

The undersigned hereby binds himself upon acceptance of this proposal to execute a Contract with the City of Del City and proposes and agrees to deliver the equipment within the time herein stated and to perform all work of whatever nature required in strict accordance with the specifications for the following price to wit:

BID SCHEDULE FOR
PRE-PURCHASE EQUIPMENT SUPPLY FOR DEL CITY WATER TREATMENT PLANT

(Bidders shall attach Bid Submittal data per Section 00 50 00 “Special Conditions”, Paragraph 1.3, including an itemized quotation of components included in the bid including quantity, size, and description.)

BASE BID ITEMS

Item No.	Quantity	Unit	Description	Extended Amount
1.	1	Lump Sum	For all Work defined in the Contract Documents to supply the complete Flocculating Clarifier Equipment System (West Unit), for a total lump sum amount of _____Dollars and _____Cents.	$

Alternate Bid Items: Alternate Bid Items shall adjust the TOTAL BASE BID amount as required to perform the alternate work. Adjustments shall be made on the Base Bid Item for which the Alternate Bid Item serves as an alternate.

Item No.	Quantity	Unit	Description	Extended Amount
A1.	1	Lump Sum	For all Work defined in the Contract Documents to supply the complete Flocculating Clarifier Equipment System (East Unit), for a total lump sum amount of _____Dollars and _____Cents.	$

TOTAL BASE BID PLUS ALTERNATE BID ITEMS (Items 1+ A1) $_____

The undersigned agrees to furnish shop drawings and to deliver equipment covered by these Documents within the time periods specified in Section 00 21 13 “Instructions to Bidders for Equipment Supply” Paragraph 1.2.D, "Time of Completion". In the event that the equipment is not delivered within the allotted time as specified herein, the OWNER will assess liquidated damages to the SUPPLIER through the CONTRACTOR in accordance with Paragraph 1.12 of Section 00 50 00 “Special Conditions”.

In the event of award of a Contract to the undersigned, the undersigned will appear before the authorized representative of the OWNER to execute the Contract under the terms and conditions specified herein and furnish a Performance Bond and Payment Bond for the full amount of the Contract ensuring and guaranteeing the work until final completion and acceptance. The undersigned guarantees payment of all lawful claims for labor performed and materials furnished in fulfillment of the Contract.

The work proposed to be done shall be accepted when fully completed and finished in accordance with the Specifications, to the satisfaction of the OWNER.

The undersigned certifies that the bid prices and quantities contained in this Proposal have been carefully checked and are submitted as correct and final.

Receipt is hereby acknowledged of the following addenda to the Contract Documents:

Addendum No. 1 dated _____ Received _____
Addendum No. 2 dated _____ Received _____
Addendum No. 3 dated _____ Received _____
Addendum No. 4 dated _____ Received _____
Addendum No. 5 dated _____ Received _____

Attested by:

_____
Signature

_____
Printed Name and Title

Respectfully submitted,

_____
Signature

_____
Printed Name and Title

_____
Mailing Address

_____
Street Address

_____
City and State

_____
Telephone Number

NOTE: Bid forms may be copied or detached from this bound document. Fill in with ink and submit complete with required forms and itemized quotation of components included in the Bid. **Do not insert exceptions, deletions or conditional statements to this proposal.**

END OF SECTION

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SECTION 00 45 19
NON-COLLUSION AFFIDAVIT

STATE OF OKLAHOMA COUNTY OF _____

OWNER: _____
_____
_____

CONTRACT
Date: _____
Amount: _____
Description (Name and Location): _____

_____, of lawful age, being first duly sworn, says that (he/she) is the agent authorized by the Bidder to submit the attached Bid.

Affiant further states that the Bidder has not been a party to any collusion among Bidders in the restraint of freedom of competition by agreement to bid at a fixed price or to refrain from bidding; or with any official or employee of the OWNER as to quantity, quality, or price in the prospective Contract, or any other terms of said prospective Contract; or, in any discussion between Bidders and any official of the OWNER concerning exchange of money or other thing of value for special consideration in the letting of a Contract.

Company Name: _____
(typed or printed)

By: _____
(signature – attach evidence of authority to sign)

Name: _____
(typed or printed)

Title: _____
(signature – attach evidence of authority to sign)

Business Address: _____

Phone:_____ Facsimile: _____ E-mail: _____

SUBSCRIBED AND SWORN BEFORE ME, this _____ day of _____, ____.

Notary Public

My Commission Expires:

THIS FORM MUST BE RETURNED WITH YOUR BID
END OF SECTION

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SECTION 00 52 13
AGREEMENT

STATE OF OKLAHOMA §

COUNTY OF OKLAHOMA §

This Agreement, made and entered into this ____ day of _____, 2024, by and between the City of Del City (hereinafter called "OWNER") and _____, of the City of _____, County of _____, and State of _____, (hereinafter called "SUPPLIER").

WITNESSETH:

WHEREAS, in accordance with law, OWNER has caused Contract Documents to be prepared and an Invitation to Bid to be published, for and in connection with DEL CITY WATER TREATMENT PLANT PRE-PURCHASE EQUIPMENT SUPPLY (hereinafter called "WORK" or "PROJECT"); and

WHEREAS, SUPPLIER, in response to the Invitation to Bid, has submitted to OWNER, in the manner and at the time specified, a sealed Bid in accordance with the Instructions to Bidders; and

WHEREAS, OWNER, in the manner prescribed by law, has publicly opened, examined, and tabulated the Bids submitted, and has determined SUPPLIER to be the responsive, responsible bidder with most advantageous bid for:

Flocculating Clarifier Mechanisms Replacement Pre-Purchase Equipment Supply

and duly awarded to SUPPLIER a contract therefor, for the Base Bid named in SUPPLIER's Bid with or without the deduct as determined solely by OWNER.

NOW, THEREFORE, in consideration of the compensation to be paid to the SUPPLIER and the mutual agreements herein contained, the parties to these presents have agreed and hereby agree as follows:

ARTICLE I
WORK

SUPPLIER shall accept a purchase order from the CONTRACTOR and commence and complete the equipment supply SCOPE and all work in connection therewith, including the assumption of all obligations, duties, and responsibilities necessary for the successful completion of the Contract and the furnishing of all materials and equipment required to be incorporated in and form a permanent part of the WORK; tools, equipment, supplies, transportation, facilities, labor, superintendence, and services required to perform the WORK, and bonds, insurance, and submittals; all as indicated or specified in the Contract Documents to be performed or furnished by the SUPPLIER for the WORK included in and covered by OWNER's award of this contract to the SUPPLIER, such award being based on the acceptance by OWNER of SUPPLIER's Bid.

ARTICLE II
ENGINEER

The PROJECT has been designed by the firm of Plummer Associates, Inc., who is hereinafter called ENGINEER and who will assume all duties and responsibilities and will have the rights and authorities assigned to ENGINEER in the Contract Documents in connection with completion of the WORK in accordance with the Contract Documents.

ARTICLE III
TIME OF COMPLETION

The SUPPLIER shall complete and submit the shop drawings within 56 calendar days (8 weeks) of receipt of the Notice to Proceed issued by the OWNER or by the ENGINEER for the OWNER or receipt of a Purchase Order from the CONTRACTOR (whichever occurs first) and further agrees to deliver all equipment within 210 calendar days (10 weeks) beginning 5 days after the date the first submittal is returned to the SUPPLIER.

ARTICLE IV
CONTRACT SUM

The OWNER shall pay to the SUPPLIER (through the Contractor) for performance of the WORK, and the SUPPLIER shall accept as full compensation therefor the following sums (subject to adjustments for actual quantities and as provided in the Contract Documents):

Total Amount $_____

for all WORK covered by and included in the contract award and designated in ARTICLE I, payment thereof to be made in current funds in the manner provided in the Contract Documents.

ARTICLE V
CONTRACT DOCUMENTS

The WORK shall be performed in accordance with the Contract Documents which consist of the signed Agreement, the Addenda, Change Orders, Field Orders, Notice to Proceed, the Special Conditions, Instructions to Bidders, Notice of Award, Invitation to Bid, the Bid, the Bid Bond, the Specifications, and any Special Bonds.

ARTICLE VI
PAYMENT

Payments will be made to the Supplier (through the CONTRACTOR) in accordance with Section 00 50 00 “Special Conditions”, Paragraph 1.13 PAYMENT. Five percent (5%) will be retained by OWNER until successful performance testing is completed and final acceptance of OWNER is granted.

IN WITNESS WHEREOF, the Parties to these presents have caused this AGREEMENT to be executed in several counterparts, each of which is deemed to be an original and as of the day and date first written above.

CITY OF DEL CITY

_____

City Manager

ATTEST:

_____

_____ (SUPPLIER)

By: _____

ATTEST:

_____

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SECTION 00 50 00
SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Work to be done consists of furnishing and delivering in satisfactory condition, the equipment described in the Technical Specifications to the specified points of delivery and providing installation guidance, startup, testing, and other services where specified in the detailed technical specifications. The SUPPLIER shall be responsible for instructing the installation CONTRACTOR in the proper installation of the equipment, inspecting the installed equipment, placing it in service and furnishing an installation report, and assisting and training the OWNER's personnel in start-up and operation of the equipment.

B. The equipment to be furnished under this equipment supply bid document is to be incorporated in a construction project for the City of Del City Water Treatment Plant. A separate contract will be awarded for the construction project which includes the installation of the equipment obtained under these Documents.

1.2 PREBID SUBMITTAL REQUIREMENTS

A. Prior to the Prebid submittal date indicated in the Invitation to Bid, Equipment Suppliers who are not named in the specifications, but who wish to bid this project, shall furnish prebid submittal data (minimum two (2) copies) for the purpose of prequalification. Prebid submittal data shall consist of:
   1. A list of at least twenty (20) operating installations of comparable size which employ the specified equipment system or unit, with capacity/size, telephone numbers and names of persons to contact and dates placed on-line. Comparable size shall be defined as at least 50 percent of the capacity as specified for the system.
   2. The location of the nearest spare parts inventory and equipment repair facilities, or description of how parts and/or services can be provided within 48 hours of request.
   3. The name, address, and telephone number of the individual who will represent the SUPPLIER.
   4. SUPPLIER corporate overview indicating years of operation in the United States.
   5. Product data, catalog information, schematics, necessary for ENGINEER to understand the nature of the equipment proposed.
   6. Deviations requested or exceptions to specifications requested (if any) must be clearly identified.

B. The Bidder's product shall not differ from the basic requirements specified herein. If Bidder's product differs from minor specified requirements and/or catalog description, each point of difference shall be clearly stated on a separate sheet. Exceptions and deviations requested will be reviewed by the ENGINEER and OWNER. Significant exceptions and/or deviations may be cause for rejection of the potential SUPPLIER. In the absence of stated deviations and exceptions, it shall be understood that the proposed equipment complies in every respect to the specification. Items not changed by Addendum shall be bid per the specifications. The requirements under this item are set forth to facilitate the technical evaluation and shall not be construed by the bidder as waiving any of the requirements of the Specifications and Contract Documents. Submittal data shall be in such form and so

presented that the ENGINEER may readily review the data and determine whether or not the equipment will meet the intent Specifications and Contract Documents.

C. Prebid submittal data shall be submitted directly to Mr. Jason Laubacher, P.E., Plummer Associates, Inc., 531 Couch Drive, Suite 200, Oklahoma City, Oklahoma 73102. The Prebid submittal data shall be submitted no later than seven (7) days prior to the date of the bid opening. Prebid submittal data submitted within seven (7) days of the bid opening date will not be reviewed.

D. At least 7 days before the bid opening, the OWNER will indicate by Addendum additional names of the system suppliers, if any, who are approved to submit bids for this project.

E. Bids will be evaluated for conformance with the documents in all respects. Bids will be received only from Bidders that have been identified in the Specifications or in the Addendum by the OWNER for which prebid submittal data has been approved. All other Bids will be returned unopened.

F. No equipment shall be supplied from any SUPPLIER not regularly engaged in the manufacturing and production of equipment of the size and character herein specified. Unless otherwise indicated, SUPPLIERS must have installed and had in satisfactory operation for a period of not less than five (5) years, at installations in the United States, at least twenty (20) equipment system or unit of size, model and type comparable to the equipment systems and shall submit evidence of such manufacture and operation with their prebid submittal. A list of similar installations shall be furnished upon request, including names and telephone numbers of contacts.

G. In addition, SUPPLIER shall show evidence of facilities within 500 miles of the OWNER, which have a spare parts inventory and the capability for providing repair services for the systems or equipment units. If this location requirement cannot be met, the SUPPLIER must demonstrate that the required parts and/or services can be provided within 48 hours of request.

1.3 BID SUBMITTAL REQUIREMENTS

A. All bidders shall furnish Bid submittal data (minimum three (3) copies) with each bid package submitted. Bid submittal data shall consist of:

1. Dimensional data, equipment plan and section drawings, elevations, equipment capacities, manufacturer's brochures with model numbers indicated or marked, and equipment weights for all of the equipment, instrumentation, electrical, and controls proposed.
2. Electrical loads and completed motor data sheets.
3. Schematic process flow diagrams for all systems, showing all major equipment and overall process configuration.
4. Schematic of control system architecture.
5. Arrangement drawings showing how equipment will be configured, based on and in accordance with informational drawings provided by ENGINEER.
6. Extent of fabrication and assembly.
7. Equipment interconnection sizes and centerline dimensions.
8. Materials of Construction for all components.
9. Itemized questionnaire, a complete listing of all items furnished with quantities, manufacturers, model numbers, descriptions, and sizes.
10. Information on pipe and fittings, materials, coatings, and linings.
11. Warranties and Guarantees.

B. Bids received without Bid submittal data will be judged nonresponsive.

1.4 ASSIGNMENT OF PRESELECTED EQUIPMENT

A. The OWNER reserves the right to reject any and all Bids on any or all items and waive any and all formalities or technicalities, and may disregard any non-conforming, non-responsive, or conditional Bid or counter proposal.

B. In evaluating Bids, the OWNER will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and alternates. He may conduct such investigations as he deems necessary to establish the responsibility, qualifications, proposed Subcontractors and other persons and organizations to do the work in accordance with the Documents to OWNER's satisfaction within the prescribed time. The OWNER reserves the right to reject the Bid of any Bidder who does not meet any such evaluation to the OWNER's satisfaction.

C. If a contract is to be awarded, it will be awarded to the responsive, responsible Bidders with the lowest total cost that is in the best interests of the Project for the Flocculating Clarifier Equipment. In order to determine the lowest cost bid that is in the OWNER'S best interest, the OWNER reserves the right to consider operation and maintenance costs and non-cost factors in evaluating the Bids.

D. Each equipment SUPPLIER submitting a proposal shall furnish, as a part of his bid, the Bid Submittal Data in Paragraph 1.3 which includes an itemized quotation with quantity, size and description for all components, as well as other information. Such data relating to the equipment proposed shall become a part of these specifications as it applies to the separate contract for installing the equipment. It shall be understood that equipment to be supplied conforms in every respect to these Bid Documents.

E. It is expected that the OWNER's evaluation of bids and assignment of equipment contracts will be made as set forth in the Invitation for Bids and Instructions to Bidders. The successful bidder(s) will be notified by a Notice of Award. Time of completion is very important and failure to meet the completion schedule will subject the SUPPLIER to liquidated damages as provided in the Special Conditions.

F. The OWNER will issue a Notice of Award to the SUPPLIER for the equipment being furnished by SUPPLIER in accordance with the accepted Proposal. It is the intent of the OWNER to execute a Contract with the SUPPLIER and assign the equipment Contract to a CONTRACTOR to be selected at a later date for the construction of the proposed project. The SUPPLIER shall execute the Contract Agreement and Performance and Payment Bonds on the forms provided herein and in accordance with the terms and conditions herein specified. The bonds shall be named to the City of Del City and shall not be assigned to the CONTRACTOR. The Contract Documents between the City of Del City and the CONTRACTOR will be in accordance with the General Contract Documents for the Construction of the Del City Water Treatment Plant, together with all subsequent addenda thereto, and will contain a Performance Bond and Payment Bond in accordance with statutory requirements.

G. The CONTRACTOR will issue a purchase order to the SUPPLIER which shall initiate the submittal and delivery schedule if the OWNER or ENGINEER has not already issued a Notice to Proceed. The OWNER or ENGINEER for the OWNER may issue separate Notice to Proceed letters prior to the CONTRACTOR's purchase order to define the dates for the shop drawing submittal and for fabrication and delivery. The OWNER or ENGINEER may issue a separate Notice to Proceed to the SUPPLIER to begin fabrication following review of submittals if the

CONTRACTOR has not been selected or has not issued a Purchase Order to the SUPPLIER. SUPPLIER shall not begin work until notified to do so by either the receipt of a purchase order or Notice to Proceed. Should for any reason the OWNER fail to enter into a general contract for installation after the OWNER has issued a Notice to Proceed to the SUPPLIER, then the OWNER will make payments directly to the SUPPLIER as specified in Paragraph 1.13 - PAYMENT. The OWNER shall not be liable for any costs incurred prior to the issuance of the Purchase Order or the Notice to Proceed.

H. The CONTRACTOR will be assigned all responsibility of executing the purchase order, scheduling, ordering, obtaining submittals, receiving, inspecting, unloading, protecting, installing and paying for the equipment furnished by the SUPPLIER.

I. The CONTRACTOR will purchase and make payments directly to the SUPPLIER for the equipment in accordance with the terms of these Documents, and the terms of Payment as described herein, from money received by the CONTRACTOR from the OWNER in payment for materials and equipment.

J. The CONTRACTOR will be required to work with the SUPPLIER in scheduling delivery of equipment and dates that the SUPPLIER's representatives shall be available to assist in installation, adjusting, start-up, and testing of the equipment as specified herein.

1.5 BID DOCUMENTS

A. The Bid Documents consist of Invitation for Bids, Instructions to Bidders for Equipment Supply, Bid (Proposal), Bid Bond, Contract Agreement, Performance and Payment Bonds, these Special Conditions, Specifications, Drawings, and all modifications thereof incorporated in any of the documents before the bid date.

B. The Bid documents are complementary, and what is called for by any one section shall be as binding as if called for by all. In the event of a conflict in the Documents, the SUPPLIER shall call the conflict to the ENGINEER's attention in writing, and the ENGINEER shall decide the conflict in writing. The ENGINEER's decision shall be binding.

1.6 DEFINITIONS

A. Whenever the words, forms, or phrases defined herein, or pronouns used in their place occur in the Contract Documents, warranties, or in any document or instrument herein contemplated, intent and meaning shall be interpreted as follows:

Agreement	Contract between the OWNER and the successful equipment supply bidder that bidder will accept a purchase order from the general contractor.
ANSI	American National Standards Institute
ASA	American Standards Association
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CONTRACTOR	General Contractor, Installation Contractor, or Construction Contractor and their subcontractors,

	selected by the OWNER for the construction of the Howard Road Water Treatment Plant project.
ENGINEER	Plummer Associates, Inc. and its subconsultants.
Proposal	The written Proposal to the OWNER from the SUPPLIER describing the equipment to be supplied.
GPM or gpm	Gallons per minute
MGD	Million gallons per day
NEMA	National Electrical Manufacturers Association
Notice of Award	A written notice by OWNER to the apparent successful bidding SUPPLIER stating that OWNER is requesting the SUPPLIER to enter into a Contract Agreement which will be assigned to the successful General Contractor.
Notice to Proceed	A written notice given by OWNER or ENGINEER, to SUPPLIER fixing the date on which the Contract Time for submittals will commence to run and on which SUPPLIER shall start to perform his obligations under the Bid Documents.
OWNER	City of Del City
Standard Methods	Standard Methods for the Examination of Water and Wastewater, published by the American Public Health Association, latest edition.
SUPPLIER	The manufacturing company (Equipment Manufacturer, Vendor) or its duly authorized agent, furnishing the equipment specified and bid under these Specifications and Contract Documents.

1.7 MATERIAL AND WORKMANSHIP

A. Material used in the manufacture of equipment offered shall be high grade and quality throughout and shall be entirely suitable for the purpose specified in the Contract Documents and specifications. Workmanship shall be in accordance with high grade manufacturing practice covering the type of equipment. Construction and design shall be in full accordance with modern practice. All parts shall be readily accessible in the United States and like parts shall be interchangeable. Only new equipment will be acceptable, and any proposal for furnishing used or rebuilt equipment will be rejected.

1.8 PATENTED DEVICES, MATERIALS AND PROCESSES

A. If the SUPPLIER is required or desires to use any design, device, material, or process covered by letter patent, or copyright, SUPPLIER shall provide for such use by suitable legal

agreement with the patentee or holder of such patent letter or copyrighted design. It is mutually agreed and understood that, without exception, the purchase prices shown in the proposal shall include all royalties or cost arising from patents, trade-marks, and copyrights in any way involved in the work.

1.9 SUBMITTALS

A. The SUPPLIER shall submit Bid submittals, Shop Drawings, Operation and Maintenance Manuals, Certified Test Reports, Warranties, Service Agreements, Equipment Installation Reports, and certification as required by and in accordance with Section 01 43 33 “Supplier’s Submittals” of the Contract Documents. SUPPLIER shall submit seven (7) copies of each shop drawing to ENGINEER for review, and two additional copies for CONTRACTOR plus any copies SUPPLIER wishes to have returned. OWNER and ENGINEER shall retain seven (7) copies and two (2) copies will be for the CONTRACTOR. ENGINEER will return the balance of copies submitted of each reviewed shop drawing to CONTRACTOR (if selected). The ENGINEER will make every attempt to limit turnaround time for submittal review to two (2) weeks.

1.10 DELIVERY

A. Packing for Shipment: The equipment provided under the specifications shall be shipped by SUPPLIER in such manner as to insure arrival at destination in an undamaged condition with the current issue of the Consolidated Freight Classification. Assemble equipment in factory to largest practical components to insure proper fit, and mark parts for shipment and assembly at the project site. All equipment and parts shall be suitably protected to insure against breakage or damage in transit.

B. Point of Delivery: Equipment shall be delivered by the SUPPLIER by motor freight trucks at the Del City Water Treatment Plant Site in Oklahoma County, Oklahoma with specific instructions to be furnished by the CONTRACTOR at the time of delivery. The plant site is located in Del City, Oklahoma.

C. Receiving: Equipment will be inspected by the CONTRACTOR upon delivery, and if found to be in satisfactory condition, will be unloaded by the CONTRACTOR. This inspection is only for the purpose of determining apparent damage in transit, if any. CONTRACTOR shall be responsible for proper storage of the delivered equipment until it is installed.

1.11 TIME OF DELIVERY

A. The OWNER desires that the equipment be delivered at the earliest possible date. Notice of Equipment Assignment will be issued by the OWNER following equipment preselection. The CONTRACTOR, who will be assigned the preselected equipment, will be determined after the equipment preselection. The Notice to Proceed for the equipment covered in these Specifications will be issued following award of the General Construction Contract. The time periods are indicated in Section 00 21 13 “Instructions to Bidders for Equipment Supply” for the time required to submit shop drawings and the time required to make deliveries of equipment.

B. Deliveries shall not be considered complete until all equipment and materials necessary for a complete installation has been received at the plant site. For deliveries after the allowed time period, OWNER may withhold liquidated damages from the amount due the SUPPLIER in accordance with Paragraph 1.12.

1.12 LIQUIDATED DAMAGES

A. The SUPPLIER agrees that time is of the essence to this Project. In the event that the equipment is not delivered complete and ready for installation by the time indicated in Section 00 21 13 “Instructions to Bidders for Equipment Supply”, 1.2.D, Time of Completion (after due allowance for such extension of time as is provided below), the OWNER (through the General Contractor) may permanently withhold from the SUPPLIER's total compensation, an amount equal to $250 per calendar day, limited to 15 percent of the total amount bid. The OWNER reserves the right to deduct that amount for each day above the allotted time until complete delivery of equipment has been made. Statements in the SUPPLIER’s bid limiting or not agreeing to the liquidated damages will not be accepted. Liquidated damage amounts shall be applied to the SUPPLIER’s total compensation amount prior to determining the payment percentage after submittals in Paragraph 1.13.

B. Should the SUPPLIER be delayed by any negligence of the CONTRACTOR, OWNER, or ENGINEER, or of any of their employees, or by changes ordered in the work, or by unforeseeable causes beyond the control of and without the fault of the SUPPLIER, then an extension of time sufficient to compensate for the delay will be allowed. A request for an extension of the Time of Delivery shall be fully documented and shall be made within fifteen (15) calendar days from the time such delay was alleged to have occurred.

1.13 PAYMENT

A. Following ENGINEER's review of the complete shop drawing submittal, including all required attachments, the OWNER will approve payment to the CONTRACTOR on the monthly estimate following review, an amount equal to five percent (5%) of the contract amount for the equipment described by the submittal. Upon satisfactory completion of required factory tests and delivery of all of the specified equipment and materials, complete, to the job site in good condition, the OWNER will approve payment to the CONTRACTOR on the monthly estimate following the delivery of equipment, as materials on hand, an additional amount equal to seventy percent (70%) of the contract amount. Portions of this amount will be paid in the monthly pay estimates proportionate to the amount of materials delivered to the jobsite. Following (1) installation of required equipment by CONTRACTOR and receipt of the final Operations and Maintenance Manuals; following completion of inspection by SUPPLIER, and (2) receipt of the specified Installation Reports, the OWNER will approve payment to the CONTRACTOR on the monthly estimates following completion of these two items additional amounts each equal to 10 percent (total of 20 percent) of the contract amount thereof. Payment of the remaining 5 percent (5%) of the contract amount will be approved to the CONTRACTOR on the monthly pay estimate following the seven (7) day start-up period, successful completion of performance testing, and final acceptance of the equipment by the OWNER. Additional retainage will not be deducted from these amounts.

B. If, through no fault of the SUPPLIER, the equipment has been delivered but has not been installed within 180 days of delivery, and the equipment has been ready for installation for at least three (3) months and Final O&M Manuals have been furnished, provisional acceptance of the equipment may be made by OWNER to allow payment of a portion or all remaining funds due SUPPLIER. SUPPLIER shall conduct operator training and instruct OWNER's personnel in maintenance and storage of equipment, upon request.

C. The CONTRACTOR, after receipt of written approval from the OWNER, will pay the SUPPLIER the above stated amount within twenty (20) days after receipt of payment from the OWNER. The CONTRACTOR will be required to certify that all payments approved by the

OWNER, as specified above, have been made to the SUPPLIER prior to approval of the following monthly estimate.

D. The selection of equipment covered by this Document, or the approval of payment therefore, shall in no way constitute a waiver by the OWNER of its rights to return or reject such equipment and/or claim damages for: (a) non-compliance with the terms of the Documents, (b) breach of expressed or implied warranty, or (c) the enforcement of any legal rights which the OWNER may have under this Document.

E. Should for any reason the OWNER fail to enter into a general contract for installation, then the OWNER will notify the SUPPLIER in writing that a Notice to Proceed and a Purchase Order will not be issued, and all agreements and obligations between the OWNER and the SUPPLIER for this project will be canceled.

F. Should the OWNER fail to execute a contract with a General Contractor, after notifying the supplier of acceptance of his bid and authorizing him to proceed with shop drawings, and after receipt of the shop drawings, the OWNER agrees to pay 5 percent (5%) of the price bid to the low bidder.

G. The OWNER may cancel the Contract between the OWNER and SUPPLIER for any reason prior to issuing a Notice to Proceed or a Purchase Order to the SUPPLIER without any financial obligation from the OWNER to the SUPPLIER.

1.14 EQUIPMENT WARRANTY

A. The SUPPLIER shall guarantee that all equipment, including all components of the complete assembly furnished by it hereunder, complies in all respects with the design and specifications of these documents and contains no defects of material or workmanship, for a period of 24-months following Final Acceptance or 30-months from delivery. In the event of failure of any part or parts of the equipment due to defects of design, materials, or workmanship, the affected part or parts shall be replaced promptly upon notice by the OWNER. All replacement parts shall be furnished, delivered, and installed at the expense of the SUPPLIER.

B. The warranty period shall be interpreted as the 24-month period following the Final Acceptance or 30-months from delivery of the SUPPLIER-furnished equipment by the OWNER as provided below, and shall be exclusive of the time of use of the equipment in installation, testing, adjusting, etc., during the construction period, or of the time in storage, after delivery and prior to installation. Provisional acceptance of the equipment as described above in Paragraph 1.13, PAYMENT, shall not affect the determination of the beginning of service. All equipment shall be operated for a minimum 7-day startup period and shall successfully complete the performance testing before final acceptance and before the start of the warranty period.

1.15 SUPPLIER'S TECHNICAL REPRESENTATIVE

A. The SUPPLIER shall furnish the services of a competent, factory-trained field service technical representative (not a salesman), who shall have had experience in the installation and operation of the equipment which is being selected under this Bid Document. This service is for the purpose of insuring proper installation and adjustment of the equipment; instructing operating personnel in proper operation, maintenance, and care of the equipment; for supervising the field acceptance tests of equipment and making recommendations for obtaining the most efficient use thereof. Equipment will be installed

by the CONTRACTOR and the SUPPLIER's technical representative shall render assistance to the CONTRACTOR during installation. The OWNER reserves the right to videotape the operator training sessions.

B. The service of the SUPPLIER's technical representative shall be made available during the construction period for assistance to the CONTRACTOR for adjusting and checking of equipment as described herein.

C. In the event the services of the SUPPLIER's technical representative are needed and requested by the CONTRACTOR for periods longer than indicated in the specifications, payment for such services shall be made by the CONTRACTOR. No payment will be due for time spent by the technical representative due to faulty design or fabrication of the equipment, or incomplete equipment delivery.

1.16 TRAINING

A. The SUPPLIER shall provide classroom and field training to the OWNER’s supervisory, operation and maintenance personnel covering the operation and maintenance of the equipment furnished as specified in the applicable specifications. Training requirements are detailed in each equipment specification.

B. Include cost of all wages, taxes, benefits, insurance, travel, and living expenses associated with the training services in the bid price.

C. At the direction of the OWNER, training classes may be repeated so that all staff may attend the training. Repeated class time counts toward the minimum total of hours specified herein.

D. Provide to the ENGINEER, in writing, at least 30 days before initiation of training, a training schedule, course outline, and curriculum for review and acceptance by the ENGINEER.

1.17 INSTALLATION OVERSIGHT, START-UP SERVICES, FINAL ACCEPTANCE, AND FOLLOW-UP VISITS

A. The SUPPLIER shall provide installation oversight and start-up services as specified in the applicable technical specifications at the time and dates requested by the CONTRACTOR. CONTRACTOR will provide 30 days’ notice to the SUPPLIER for initiation of installation oversight and start-up services. Oversight and start-up services shall be provided by SUPPLIER’s technical representative.

B. For the Final Acceptance Test, the OWNER will operate the equipment, after installation, start-up, and operator training is complete, for a period of seven (7) days during which the equipment must operate uninterrupted, continuously, without any failure event or the need for adjustment to achieve the specified performance. If the equipment fails for any reason (e.g. a tripped breaker) or requires adjustment to achieve the specified performance during the seven (7) day test period, the Final Acceptance Test shall reset and a new seven (7) day Final Acceptance Test shall be conducted. The Final Acceptance Test procedure shall continue until the equipment successfully operates continuously, uninterrupted, without failure or need for adjustment for a seven (7) test period.

C. SUPPLIER shall provide two (2) follow up visits of one day each (2 days total) in addition to the startup, testing, and training time specified. SUPPLIER shall return to site 12 months after Final Acceptance and 23 months after Final Acceptance to review operation, equipment performance and conduct additional classroom and field training session.

D. Include cost of all wages, taxes, benefits, insurance, travel and living expenses associated with the installation oversight, start-up services, and follow up visits in the bid price.

1.18 SALES TAX

A. Equipment purchased under this contract is for the City of Del City and will be exempt from state and local sales tax. The City of Del City will provide the tax-exempt certificate.

1.19 COST OF TESTING

A. All costs of factory and field tests of equipment which are required by the specifications shall be included in the price bid for the equipment. SUPPLIER shall be responsible for all costs associated with their personnel for the specified period of field-testing and other specific costs identified in the applicable technical specifications. The CONTRACTOR will be responsible for coordinating the tests and for personnel-related costs for CONTRACTOR's employees for specific test equipment, if required, and for temporary piping, connections and other incidental items necessary for testing. Potable water is available for testing.

1.20 GIVING NOTICE

A. Whenever any provision of these Bid Documents requires the giving of written notice, it shall be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the person who gives the notice.

1.21 COMPUTATION OF TIME

A. When a period of time is referred to in these Bid Documents by days, it shall be computed to exclude the first and include the last day of such period. Except where specifically stated otherwise, such periods shall be computed as calendar days, including weekends and holidays. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, the last day shall be the next consecutive calendar day.

1.22 ADDITIONAL CONTRACT PROVISIONS:

A. The purchase order terms and conditions between the CONTRACTOR and the SUPPLIER will be based on the following.
   1. Risk of Loss:
      a. The SUPPLIER shall bear the risk of loss of, or damage to, each item purchased until each item has been delivered to the Del City Water Treatment Plant location. Upon such delivery, all risk of loss of, or damage to, each such item shall be borne by the SUPPLIER until inspected and accepted in writing by the CONTRACTOR's authorized representative. The SUPPLIER agrees that it shall maintain adequate insurance on the items purchased until accepted as required herein.
   2. New Condition:
      a. All equipment shall be new.
   3. Authorized Distributor:

a. The SUPPLIER hereby warrants that it is an authorized distributor hereby agrees that it has complete contractual responsibility and authority to sell the items being purchased.

4. Warranties:
   a. The SUPPLIER warrants and represents that the CONTRACTOR and OWNER shall acquire upon completion of payment good and clear title, free and clear of all liens, claims or encumbrances of any kind.
   b. The warranty set forth Paragraph 1.14 EQUIPMENT WARRANTY is Seller's sole and exclusive warranty. Seller makes no other warranties of any kind, express or implied.

B. Notice and Assistance Regarding Patent and Copyright Infringement:
   1. In the event of any claim or suit against the ENGINEER, CONTRACTOR or OWNER on account of any alleged patent or copyright infringement arising out of the performance of this Contract or out of the use of any supplies furnished or work or services performed hereunder, the SUPPLIER shall defend the ENGINEER, CONTRACTOR and the OWNER against any such suit or claim and hold the ENGINEER, CONTRACTOR and the OWNER harmless from any and all expenses, court costs, and attorney's fees in connection with such claim or suit. The SUPPLIER's contractual liability insurance shall cover the SUPPLIER and ENGINEER's, CONTRACTOR's and OWNER's obligations under this paragraph.
   2. This indemnification obligation shall not apply to any claim based on OWNER, ENGINEER, or CONTRACTOR's unauthorized use or modification and any claim based on damages relating to the CONTRACTOR's/OWNER's willful infringement.

C. Termination:
   1. The OWNER may, subject to the provisions below, by written notice of default to the SUPPLIER, terminate the whole or any part of this contract in any one of the following circumstances:
      a. If the SUPPLIER fails to perform within the time specified herein or any extension thereof; or
      b. If the SUPPLIER fails to perform any of the other provisions of this Contract, or so fails to make progress as to endanger performance of this contract in accordance with its terms, and in either of these two circumstances does not cure such failure within a period of ten (10) days (or such longer period as the OWNER or CONTRACTOR may authorize in writing), after receipt of notice from the OWNER specifying such failure.
      c. In the event the OWNER terminates this Contract in whole or in part, as above provided, the OWNER may procure, upon such terms and in such manner as the OWNER may deem appropriate, items purchased similar to those so terminated, and the SUPPLIER shall be liable for any excess costs for such similar items, provided that the SUPPLIER shall continue the performance of this Contract to the extent not terminated under the provisions of this paragraph.
      d. The SUPPLIER shall not be liable for any excess costs if the failure to perform the Contract arises out of causes beyond the control and without the fault or negligence of the SUPPLIER.

D. Venue:
   1. The obligations of the parties to this Contract are performable in Oklahoma County, Oklahoma, and if legal action is necessary to enforce same, exclusive venue shall lie in Oklahoma County, Oklahoma.

E. Governing Law:
   1. This Contract shall be governed by and construed in accordance with the laws and court decisions of the State of Oklahoma.

F. Legal Construction:
   1. In case any one or more of the provisions contained in this Contract shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other provision thereof, and this Contract shall be considered as if such invalid, illegal, or unenforceable provision had never been contained in this Contract.

G. Assignment:
   1. This Contract cannot be assigned without the prior written consent of the other party except as provided for in the Contract Documents for assignment of the equipment supply contract to the CONTRACTOR.

H. Counterparts:
   1. This Contract may be executed in any number of counterparts, each of which shall be deemed an original and constitute one and the same instrument.

I. Captions:
   1. The captions to the various clauses of this Contract are for informational purposes only and shall not alter the substance of the terms and conditions of this Contract.

J. Successors and Assigns:
   1. This Contract shall be binding upon and inure to the benefit of the parties hereto and their respective heirs, executors, administrators, successors and, except as otherwise provided in this Contract, their assigns.

K. Non-Discriminatory Policy:
   1. The SUPPLIER agrees that as to all of its programs and activities conducted on the subject premises, it shall comply fully with all Civil Rights Acts and specifically will not discriminate against any person on the basis of race, color, national origin, sex or by reason of being handicapped.

L. Compliance with Applicable Laws:
   1. The contract is subject to all legal requirements of the OWNER and other county laws, state and federal laws, and SUPPLIER agrees that it promptly will comply with all applicable laws, regulations, orders and rules of the state, county, city and all other governmental agencies. The SUPPLIER agrees to obtain and bear the expense of any required permit or license.

M. Entire Agreement:
   1. This Agreement embodies the complete agreement of the parties hereto, superseding all oral or written previous and contemporary agreements between the parties and relating to matters in this Agreement, and except as otherwise provided herein cannot be modified without written agreement of the parties to be attached to and made a part of this Contract.

N. Force Majeure:
   1. Neither OWNER nor SUPPLIER shall be required to perform any term, condition or covenant in this agreement so long as such performance is delayed or prevented by force majeure, which shall mean acts of God, civil riots, floods and any other cause not reasonably within the control of OWNER or SUPPLIER except as herein provided, and

which by the exercise of due diligence OWNER or SUPPLIER is unable, wholly or in part, to prevent or overcome.

O. Indemnification:

1. To the fullest extent permitted by laws and regulations, supplier shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's consultants, and the officers, directors, partners, employees, agents, and other subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the work, provided that any such claim, cost, loss, or damage:
    a. Is suffered by a third party, is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the work itself), including the loss of use resulting therefrom; and
    b. Is indemnifiable hereunder to the extent it is caused in whole or in part by any negligent act or omission of SUPPLIER, any subcontractor, any SUPPLIER, or any individual or entity directly or indirectly employed by any of them to perform any of the work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by laws and regulations regardless of the negligence of any such individual or entity.
2. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of SUPPLIER, any subcontractor, any SUPPLIER, or any individual or entity directly or indirectly employed by any of them to perform any of the work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph O.1 shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for SUPPLIER or any such subcontractor, SUPPLIER, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
3. The indemnification obligations of SUPPLIER under paragraph O.1 shall not extend to the liability of ENGINEER and ENGINEER's consultants or to the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them arising out of:
    a. The preparation or approval of, or the failure to prepare or approve, maps, drawings, opinions, reports, surveys, change orders, designs, or specifications; or
    b. Giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.
    c. Failure to comply with the ENGINEER’s Contract with the OWNER.

P. Remedies:

1. The rights and remedies of the CONTRACTOR and OWNER provided in this paragraph shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract including the right of specific performance and offset, or remedies provided under Title 12A of the Oklahoma Uniform Commercial Code, et. seq.

Q. Non-Waiver:

1. Approval of OWNER shall not constitute nor be deemed a release of the responsibility and liability of SUPPLIER, its employees, agents or associates under the Contract nor shall approval be deemed to be the assumption of such responsibility by OWNER.

R. Permits and Licenses:

1. The SUPPLIER will maintain in effect during the term of this Agreement any and all federal, state and/or local licenses and permits which may be required of the SUPPLIER generally.

S. Limitation of Liability:

1. Notwithstanding any other provisions of the Contract Documents, Seller's total liability arising at any time under any of the Contract Documents or otherwise in connection with completing the Project shall not exceed the Seller's contract price. Notwithstanding anything to the contrary in the Contract Documents or otherwise, under no circumstances shall Seller be liable for any incidental, consequential, special, punitive or other indirect damages other than liquidated damages expressly provided for in the Contract Documents.

END OF SECTION

SECTION 00 61 10
BID BOND

Any singular reference to Bidder, Surety, OWNER, or other party shall be considered plural where applicable.

BIDDER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):

City of Del City, Oklahoma
3701 SE 15th Street
Del City, Oklahoma 73115

BID
Bid Due Date:
Project (Brief Description Including Location):

Del City Water Treatment Plant
Flocculating Clarifier Mechanism Replacement
Pre-Purchase Equipment Supply
Oklahoma City, Oklahoma

BOND
Bond Number:
Date (Not later than Bid due date):
Penal sum _____ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature and Title

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title

Attest: _____
Signature and Title

Note: Above addresses are to be used for giving required notice.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to OWNER upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Surety's liability.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

   3.1. OWNER accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

   3.2. All Bids are rejected by OWNER, or

   3.3. OWNER fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default by Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from OWNER, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by OWNER and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 90 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

END OF SECTION

SECTION 00 61 13.13
PERFORMANCE BOND

KNOW ALL MEN BE THESE PRESENTS, that we, _____,
hereinafter called the Principal, and the _____
of, _____, a corporation duly organized under the
laws of the State of _____, hereinafter called the Surety, as Surety, are held and
firmly bound unto _____
_____,
hereinafter called the Obligee, in the sum of _____
Dollars ($_____), for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal entered into a written Contract with said Obligee dated _____,
_____, for _____
_____, all
in compliance with the plans and specifications therefore, made a part of said Contract and on file in the office of _____.

NOW THEREFORE, if said Principal shall, in all particulars, well, truly and faithfully perform and abide by said Contract and each and every covenant, condition, and part thereof, and shall fulfill all obligations resting upon said Principal by the terms of said Contract and said specifications, and if said Principal shall protect and save harmless said Obligee from any pecuniary loss resulting from the breach of any of the items, covenants and conditions of said Contract resting upon said Principal, the this obligation shall be null and void, otherwise to be and remain in full force and effect.

It is further expressly agreed and understood by the parties hereto that no changes or alternations in said Contract and no deviations from the plan or mode of procedure herein fixed shall have the effect of releasing the sureties, or any of them, from the obligations of this Bond.

IN WITNESS WHEREOF, this instrument is executed in _____ counterparts, each of which shall be deemed an original, this ____ day of _____, _____.

(_____
(PRINCIPAL
_____ (
WITNESS AS TO PRINCIPAL (BY: _____

(_____
(SURETY
_____ (
WITNESS AS TO SURETY (BY: _____
(ATTORNEY-IN-FACT

SECTION 00 61 13.16
Engineers Joint Documents Committee

PAYMENT BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to Owner, this obligation shall be null and void if Contractor:

2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2. Claimants who do not have a direct contract with Contractor:

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and

2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and

3. Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety that is sufficient compliance.

6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:

6.1. Send an answer to that Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2. Pay or arrange for payment of any undisputed amounts.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1. Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

15.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone
Surety Agency or Broker:
Owner's Representative (engineer or other party):

SECTION 00 62 16
CERTIFICATES OF INSURANCE

This sheet is blank and is to be replaced with the Certificates of Insurance when provided by the Contractor.

This page intentionally left blank.

SECTION 01 43 16
SUPPLIER'S SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The SUPPLIER shall submit descriptive information to:
   1. Advise the OWNER whether the materials and equipment proposed for the project are in general conformance with the design concepts and in conformance with the Contract Documents and Specifications.
   2. Provide a record for the OWNER of the materials and equipment which have been incorporated into the project.
   3. Provide a guide for operations and maintenance of equipment.
   4. Provide information required for the administration of the Contract for construction of the project. This section of the specifications provides a more detailed description of the requirements for submittals as outlined in the Special Conditions but does not alter any requirement for submittals as described in the Special Conditions.
   5. The CONTRACTOR will make available to the OWNER and ENGINEER all submittals over an Internet-Based Construction Management System for documentation and tracking.

B. Additional submittals associated with the bidding process shall be provided as specified in the Front-End Documents.

1.3 SUPPLIER'S RESPONSIBILITIES

A. The SUPPLIER shall be responsible for the accuracy and completeness of the information contained in each submittal and shall insure that the values, material, equipment, or method of work shall be as described in the submittal. The following responsibilities will be assigned to the CONTRACTOR: All submittals must be stamped by the CONTRACTOR, indicating that they have been checked by the CONTRACTOR for compliance with the Contract Documents and approved by the CONTRACTOR, or contain certifications as required by the Contract Documents. Submittals that do not have the stamp applied or include the required certifications will be returned without processing to the CONTRACTOR.

B. The SUPPLIER shall insure that there is no conflict with other submittals and notify the ENGINEER of each case where the proposed change may affect the work of another SUPPLIER or OWNER. The SUPPLIER in coordination with the CONTRACTOR shall insure coordination of submittals among the related crafts and subcontractors. Submittals will not be accepted from sub-contractors.

PART 2 - PROCEDURES

2.1 MARKING OF SUBMITTALS

A. A number shall be assigned to each submittal provided to the ENGINEER to allow each submittal to be tracked while processing through the review procedures. The CONTRACTOR will assign the numbers on the Internet-Based Construction Management System.

B. Assignment of numbers shall be by means of a letter prefix, a sequence number, and letter suffix to indicate resubmittals.

C. The sequence number shall be issued in chronological order for each type of submittal. Resubmittals shall be followed by a letter of the alphabet to indicate the number of times a submittal has been sent to the ENGINEER for processing. As an example, a submittal with the number 25 indicates that the submittal is the 25th submitted. Submittal number 25-A indicates the submittal is being submitted for the second time.

D. Correct assignment of numbers is essential as different submittal types are processed in different ways. Some submittals received do not require that any response be given for the material. A log of submissions to allow the processing of SUPPLIER's submittals will be maintained by the CONTRACTOR and ENGINEER on the Internet-Based Construction Management System and will be monitored. Logs will be reviewed periodically to determine that all submittals are received and processed.

E. Submittals shall be marked to show clearly the applicable sections of the specification and sheet number of drawings.

F. Submittals shall be accompanied by a Submittal Transmittal Form to be provided by the ENGINEER. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate discrete sections, etc. for which a submittal is required. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that they should be checked as a unit.

2.2 DEVIATIONS FROM CONTRACT DOCUMENTS

A. Any change in the contract documents that is requested will be initiated by the SUPPLIER issuing a Contract Modification Request or by ENGINEER issuing a Proposed Contract Modification on the form provided by the ENGINEER. The SUPPLIER's Modification Request shall fully identify and describe the deviations and state the reason the change is requested. Any savings in cost related to the substitution is to be stated in the request for consideration. Modification requests will be considered and if found acceptable will be incorporated in a Field Order or Change Order as a change to the CONTRACTOR's scope in accordance with the General Conditions.

2.3 SHOP DRAWINGS

A. Definition:
   1. Shop drawings consist of all drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for the SUPPLIER to illustrate some portion of the work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a supplier and submitted by SUPPLIER to illustrate material or equipment for some portion of the Work.
   2. Shop drawings shall indicate the kind, exact model, size, arrangement, and operation of component materials and devices; materials of construction, external connections,

anchorages and supports required; performance characteristics; dimensions, weights, and other information required for installation and correlation with other materials and equipment.

B. Schedule for Submittal of Shop Drawings:
   1. The SUPPLIER shall provide schedule information so that the CONTRACTOR can submit a schedule indicating the time and sequence in which Shop Drawings are to be submitted. This schedule shall take into consideration time for delivery and a reasonable time for review of shop drawings. Proposed order and delivery dates shall be incorporated in the Progress Schedule.
   2. Shop drawings will generally be reviewed in the order in which they are received. Drawings marked "Priority" will be reviewed ahead of other shop drawing submittals not so marked which have already been received but are not yet being reviewed. SUPPLIER shall be aware that checking of "Priority" shop drawings may delay the review of other drawings which have already been submitted by the SUPPLIER and the use of this designation is to be used with discretion.

C. Contractor's Review and Certification:

   1. The CONTRACTOR shall verify that the material and equipment in each shop drawing conforms to the requirements of the Contract Documents. Shop drawings shall comply with the Contract Documents and shall bear an executed statement to that effect by the CONTRACTOR. Shop Drawings without this stamp applied will be returned without review.

D. Requirement for Complete Shop Drawings:
   1. Material in shop drawings shall be in sufficient detail to demonstrate compliance with all requirements of the Contract Documents. Shop drawings shall address material and/or methods of construction, design criteria, performance characteristics, and Special Conditions of the Specifications.
   2. Shop drawings for systems and related equipment shall include information for all components required for a complete and operational system, including electrical, mechanical, and any other information required to indicate how the various components of the system function, and shall be included in the same submittal.
   3. Where statements of certification, written guarantees, extended service agreements or extended warranties as defined in Paragraph I are required, they will be provided with the shop drawing. The effective date of the guarantee and service agreements, however, shall not be until the date specified in the Contract Documents.
   4. Shop drawings shall be clearly marked to show the applicable sections of the specifications and sheet in the drawings. Other identification may also be required on drawings such as layout drawings or schedules to allow the reviewer to determine where a particular item is to be used in the project.
   5. Submit an electronic copy of the shop drawing on the Internet-Based Construction Management System in PDF format. All review comments on shop drawings by the ENGINEER or OWNER shall be posted on the Internet-Based Construction Management System in PDF format on either a review comment form or comments on the shop drawing.
   6. Shop drawings which do not have all of the information required for evaluation will be returned without benefit of review and comment.

E. Review of Shop Drawings:

1. The ENGINEER will review the data for general conformity to the Contract Documents. Comments will be made on items called to the attention of the ENGINEER for review and verification. Markings will be based on this examination and do not constitute a blanket review of the shop drawing. The ENGINEER's review does not relieve the SUPPLIER from any responsibility for errors or deviations from the Contract requirements. Shop drawings which contain substantial error or omissions, or which are not clearly legible, will be returned without benefit of review.
2. Shop drawings will be marked in one of the four following ways:
    a. Reviewed: Shop drawings are acceptable without correction and may be distributed for construction and/or manufacture.
    b. Furnish as Corrected: Shop drawings are acceptable with minor corrections as marked and may be used with the corrections noted.
    c. Revise and Resubmit: Shop drawings having significant errors or incomplete data shall be revised and resubmitted for subsequent review after corrections have been made or additional materials are available.
    d. Rejected: Material or equipment described is not acceptable.

F. Approval of Equal Substitutions
1. Where Contract Documents allow substitution of material or equipment as an approved equal to the specified product, shop drawings shall be provided. Shop drawings shall include supporting data to indicate specifically, on a point-by-point basis for each feature of the design, how the proposed product is equal to or better than the specified product. Deviations from the Contract Documents must be requested and approved as described in Article 2.3 of this Section.

G. Shop Drawings Required
1. Shop drawings are required for all items of equipment or materials where submittals are listed in the individual specification section and for the determination of substitutions for approval as described in Paragraph F of this Article. Only these shop drawings will be reviewed. Shop drawings which are not required may be submitted for "Record Purposes" but may not be reviewed.

H. Owner Selected Options
1. Where selections are to be made by the OWNER for color, texture or finish and shop drawings are required for that product, shop drawings will be submitted for approval of the materials of construction, composition, etc., prior to the selection of finishes by the OWNER. Items requiring selection of finish for which shop drawings are not required shall be furnished as record data. Information shall be provided as soon as possible to allow OWNER adequate time to consider available options for selection. Color chips, samples, etc., for all items are to be assembled and submitted to the OWNER through the ENGINEER for selection of finishes at the same time to allow all options to be considered and allow selections to be coordinated with other items of finish. The ENGINEER will meet with the OWNER who will determine the finish to be used within 2 weeks, unless additional samples are required for selection. Materials for which shop drawings are required are to be submitted for approval of material quality prior to selection of finish.

I. Certifications, Warranties, and Other Requirements:
1. Where indicated in the Contract Documents the following items as defined below are to be provided as part of the shop drawing:
    a. **Certified Test Report** - A report prepared by an approved testing agency on the results of tests performed on materials to indicate their compliance with the

specifications. Reports are to be numbered consecutively for reference. Retest required to verify compliance with Contract Documents shall be identified with the same number as the original test with a letter to indicate retest, similar to the numbering system used for Shop Drawings.

b. **Certification of Local Field Service** - A certified letter stating that field service is available from a factory or supplier approved service organization located within an 8-hourdrive of the project site or closer as required by the individual technical specifications.

c. **Extended Warranty** - A guarantee of performance for the product or system beyond the warranty described in Paragraph 1.14 of the Special Conditions. The Warranty Certificate is to be issued in the name of the OWNER.

d. **Extended Service Agreement** - A contract to provide operations and maintenance for equipment as specified beyond that required to full requirements for warranty repairs; or to perform routine maintenance at some period beyond the warranty period. The Service Agreement is to be issued in the name of the OWNER.

e. **Certification of Adequacy of Design** - A certified letter from the manufacturer of the equipment stating that they have designed the equipment offered to account for structural stability to withstand all imposed loads without deformation, failure or adversely affecting the operational requirements of the unit; and operational capability, including mechanical and electrical equipment sizing to be fully operational in accordance with the conditions specified.

f. **Certification of Applicator/Subcontractor Qualifications** - A certified letter stating that the applicator/subcontractor proposed to perform a specified item of work is duly designated as factory-authorized and trained for the application or installation of the specified product.

2.4 RECORD DATA

A. Record data shall be submitted to provide information as to the general character, style and manufacturer of the equipment to allow the OWNER to adequately identify the materials or equipment incorporated into the project. Record data shall be provided for all equipment and materials of construction for items for which Shop Drawings are not required.

B. Record data shall be complete to indicate where the material was incorporated into the project, provide schedules of materials and their use, colors, model numbers and other information which would allow this material to be replaced at some future date. Record data will be received by the ENGINEER and logged for transmittal to the OWNER. Record data will not be reviewed for comment and no response will be made to the SUPPLIER.

2.5 OPERATIONS AND MAINTENANCE MANUALS

A. For each type of equipment to be furnished and installed under this Contract, the SUPPLIER shall prepare an operation and maintenance manual covering:

1. Name, address, and telephone number of nearest competent service organization who can supply parts and service.
2. Equipment function, normal operating characteristics, and limiting conditions, which reflect "as-built" conditions for the equipment furnished.
3. Assembly, installation, alignment, adjustment, and checking instructions, including field modification made during installation, startup and testing.
4. Operating instructions for startup, routine and normal operation, regulation and control, backwash, clean-in-place, shutdown, and emergency conditions.

5. Preventative maintenance schedule including lubrication and maintenance instructions with quantities and scheduled intervals.
6. Guide to "troubleshooting".
7. Parts lists, and predicted life of parts subject to wear. Include spare parts inventory, special storage requirements, and a vendor contact list.
8. Outline, cross-section, and assembly drawings; engineering data; control schematics and point-to-point electrical and instrumentation wiring diagrams, and reproductions of all equipment nameplates.
9. Factory test data and performance curves for equipment where factory tests are specified.
10. Line-by-line programming logic for all programmable logic controllers.
11. Safety considerations.

B. The operation and maintenance manuals shall be provided with a table of contents and each individual section shall be separated with a tab for easy reference.

C. The above information, as applicable, shall be provided for the equipment as indicated in individual specification sections.

D. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

E. Manuals shall be printed on heavy, first quality paper, 8-1/2 x 11 inch size with standard 3-hole punching. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches. Where reduction is not practicable, larger drawings shall be folded separately, and placed in envelopes which are bound into the manual. Each envelope shall bear suitable identification on the outside.

F. Submit a PDF copy of the preliminary O&M manual on the Internet-Based Construction Management System. After review by the ENGINEER, SUPPLIER shall prepare four (4) final copies of each operation and maintenance manual and deliver to the ENGINEER not later than 60 days prior to placing the equipment into operation. The final manuals shall be bound in stiff, metal-hinged binders of appropriate size, but maximum 3-1/2-inch capacity, three-post style. A copy of the final manual shall be provided in PDF format, submitted on the Internet-Based Construction Management System.

G. All information in the manuals shall be in the English language, with dimensions in US units.

2.6 REQUESTS FOR INFORMATION

A. When it is necessary for the SUPPLIER to request additional information, interpretation of the Contract Documents, or when the SUPPLIER believes there is a conflict between the drawings and specifications, he shall identify the conflict and request clarification through the CONTRACTOR using the Request for Information form. Use of this form will allow requests for information to be routed to OWNER, design engineers, design consultants or others through the ENGINEER and allow these requests to be monitored to determine that clarification is provided when needed. Sufficient information shall be attached to permit a written response without further information.

B. The ENGINEER will log each request and will review the request to determine that the information provided is adequate. If information is not adequate, the request will be returned for additional information. When adequate information is provided, the request will be reviewed and a response made. If a change is required, the ENGINEER will initiate a Proposed Contract Modification. If no change is required the ENGINEER will provide additional information required to help the SUPPLIER comply with the Contract Documents.

2.7 SCHEDULE OF VALUES AND PAYMENT ESTIMATES

A. Payment procedures shall be as described in Section 00 50 00 “Special Conditions”, Paragraph 1.13 PAYMENT. For contracts based on lump sum amounts with multiple equipment items, the CONTRACTOR is to submit to the ENGINEER for approval, a breakdown of cost for the Project. The breakdown is to provide adequate detail to allow easy determination of the percentage of completion for partial delivery payment review by the ENGINEER. Specification sections and add or deduct items in the proposal are to be used as a guide for preparing the breakdown. This breakdown is to be incorporated onto a form for the submission of payment request provided by the ENGINEER or in a form approved by the ENGINEER.

B. The CONTRACTOR is to submit a schedule showing the anticipated schedule of payments for the CONTRACTOR to assist the OWNER in determining when funds are to be made available for payment of periodic payment requests. The SUPPLIER shall coordinate with the CONTRACTOR as necessary to provide this schedule.

2.8 EQUIPMENT INSTALLATION REPORT

A. A written report shall be submitted by the SUPPLIER performing the installation check for all major equipment. This report shall certify that: 1) The equipment has been properly installed and lubricated, 2) is in accurate alignment, 3) is free from any undue stress imposed by connecting piping, equipment, or anchor bolts, and 4) has been operated under full load conditions and that it is operating satisfactorily. The report shall also indicate if and what operator training and maintenance instruction was provided and for what specific equipment.

2.9 NOTIFICATION BY SUPPLIER

A. Written notification of the need for testing, observation work by ENGINEER, or intent to work outside of regular working hours, or the request to shut down the facilities or make utility connections shall be given to the ENGINEER by issuance of a Notification By CONTRACTOR on a form provided by the ENGINEER.

END OF SECTION

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SECTION 01 43 33
MANUFACTURER'S FIELD SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the requirements for the qualifications, services, training, installation assistance, and related Work required for manufacturers' services.

B. Related Sections include the following:

1. Section 01 78 23 "Operation and Maintenance Data" for requirements for furnishing operation and maintenance information and materials.
2. Section 01 79 00 "Demonstration and Training"
3. Section 01 75 25 "Equipment Testing and Facility Startup."
4. All other Contract Documents for additional requirements.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Definitions

1. Person-Day: One person for 8 hours within regular Contractor working hours.

1.3 SUBMITTALS

A. Training Schedule: Submit not less than 21 days prior to start of equipment installation.

B. Lesson Plan: Submit proposed lesson plan not less than 21 days prior to schedule training session.

1.4 QUALITY ASSURANCE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications require of equipment manufacturer. Additional qualifications may be specified in the individual Sections.

B. Representative will be subject to acceptance by Engineer and Owner. No substitute representative will be allowed unless prior written approval has been given.

1.5 PRODUCTS (NOT USED)

PART 2 - EXECUTION

2.1 MANUFACTURERS' SERVICES

A. Furnish minimum manufacturers' services, when required by the Contract Documents, to comply with the requirements of this Section.

B. Where time is necessary in excess of that stated in the Section for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.

C. Schedule manufacturers' services to avoid conflict with other onsite testing or other manufacturers' onsite services.
D. Determine, before scheduling manufacturers' services that all conditions necessary to allow successful completion of the services have been complied with.
E. Only those days of service approved by Engineer will be credited to fulfill the specified minimum service.
F. When specified by the Contract Documents, manufacturer's onsite services shall include:
    1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, and instruction of Contractor's personnel during the assembly, erection, installation or application Work.
    2. Inspection, checking, and adjustments as required for product (system, subsystem, or component) to function as warranted by manufacturer and required to provide Manufacturer's Certificate of Installation.
    3. Provide on a daily basis copies of manufacturer's representative field notes and data to Engineer.
    4. Visiting site as required to correct problems and until installation and operation are acceptable to Engineer.
    5. Resolution of assemble or installation problems attributable to, or associated with, respective manufacturer's products and systems.
    6. Assistance during functional and performance testing, facility start-up, evaluation, and commissioning.
    7. Training of Owner's personnel in the operation and maintenance of the product as required.
    8. Additional requirements may be specified in applicable Section(s).

2.2 MANUFACTURER'S CERIFICATE OF COMPLIANCE

A. When specified in the Contract Documents, provide a Manufacturer's Certificate of Compliance, completed and signed by the entity supplying the product, material, or service prior to shipment. A copy of this form is attached to this Section.
B. Engineer may permit use of certain products, materials, or service prior to sampling and testing if accompanied by an accepted Certificate of Compliance.
C. The Certificate shall certify the product, material, or service complies with the Contract Documents. Attach supporting documentation as appropriate. This information may reflect previous test results on the product, material, or services.

2.3 MANUFACTURER'S CERTIFICATE OF INSTALLATION

A. When specified in the Contract Documents, provide a Manufacturer's Certificate of Proper Installation, completed and signed by the manufacturer's representative. A copy of this form is attached to this Section.
B. The Certificate shall certify the signing party is a dully-authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve the installation, operate their equipment, and make recommendations required to ensure the equipment installation is complete and operational.

2.4 TRAINING

A. Provide manufacturers' representative for detailed classroom and hands-on training to Owner's personnel on the operation and maintenance of specified product (system, subsystem, and component). Refer to Section 01 79 00 "Demonstration and Training" for additional requirements.

B. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner and familiar with required operation and maintenance information submitted in accordance with Section 01 78 23 "Operation and Maintenance Data."

C. Furnish training materials, which will be retained by the trainee.

2.5 EQUIPMENT TESTING AND STARTUP

A. Provide manufacturers' representative to assist Contractor for the specified product (system, subsystem, and component) on accordance with Section 01 75 25 "Equipment Testing and Facility Startup."

2.6 SUPPLEMENTS

A. The following forms located after "END OF SECTION" are part of this Section:

1. Form: Manufacturer's Certificate of Compliance.
2. Form: Manufacturer's Certificate of Installation.

END OF SECTION

MANUFACTURER's CERTIFICATE OF COMPLIANCE

Owner: _____

PRODUCT, MATERIAL OR SERVICE: _____

PROJECT NAME: _____

Comments: _____

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project has been furnished in accordance with all applicable requirements. I further certify that the product, material, or service is of the quality specified and conform in all respects with the Contract Documents, and of the quantity shown.

Date of Execution: _____

Manufacturer: _____

Manufacturer's Authorized Agent (Print): _____

_____
(Authorized Signature)

Attachments: Add comments on separate sheets as applicable.

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

Owner: _____ Serial No.: _____

Tag No.: _____ System: _____

Project No.: _____ Spec. Section: _____

I hereby certify the above referenced equipment/system has been:
(Check Applicable)

☐ Installed in accordance with manufacturer's recommendations.
☐ Inspected, checked, and adjusted.
☐ Serviced with proper lubricants.
☐ Electrical and mechanical connections meet quality and safety requirements.
☐ All applicable safety equipment has been properly installed.
☐ Functional test completed.
☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system furnished by single manufacturer)

Date of Execution: _____

Manufacturer: _____

Manufacturer's Authorized Agent (Print): _____

_____
(Authorized Signature)

Attachments: Add comments on separate sheets as applicable.

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SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 1 Section 01 42 00 "References" for applicable industry standards for products specified.
2. Division 1 Section 01 77 00 "Closeout Procedures" for submitting warranties for Contract closeout.
3. All other Contract Documents for specific requirements for warranties on products and installations specified to be warranted.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Definitions

1. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   a. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, which is current as of date of the Contract Documents.
   b. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
   c. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
2. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
3. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.3 ADMINISTRATIVE REQUIREMENTS – NOT USED

1.4 SUBMITTALS

A. Material and Equipment List. Within 60 days after Notice to Proceed, submit three copies of a complete list of major products proposed for the Project, with the name of the manufacturer and the installing entity.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title; Drawing numbers and titles; sufficient information for review by Engineer; Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated; and Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

1. Substitution Request Form: Use form provided at end of Section.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. List of similar installations for completed projects with project names and addresses and names and addresses of architects, engineers, and owners.
    g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    i. Cost information, including a proposal of change, if any, in the Contract Sum.
    j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    a. Form of Acceptance: Change Order or Field Order.

b. Use product specified if Engineer cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
   a. Form of Approval: As specified in
   b. Use product specified if Engineer cannot make a decision on use of a comparable product request within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

B. Design Requirements: Where Contractor design is specified; design of installation, systems, equipment, and components, including supports and anchorage, shall be in with provisions of International Building Code by International Code Council. Refer to the drawings for required design load criteria.

C. Environmental Requirements: Provide products suitable for installation and operation under rated conditions at 650 feet above sea level. Products installed outdoors or in unheated enclosures shall be capable of continuous operation within an ambient temperature range of 10°F to 110°F.

D. Product installations are defined as equipment furnished for an individual facility installed as part of a single project. Multiple equipment items installed as part of the same project shall not be considered multiple installations. Multiple equipment items installed at the same facility at different times as part of different projects can be considered multiple installations.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Off-site storage of materials and equipment shall be the sole responsibility of the Contractor.

1.7 SITE CONDITIONS

A. The equipment, sizes, materials, and arrangements described in this section are based on recommendations by equipment suppliers and shall be considered minimum limits of acceptability. The equipment supplier shall be responsible for design, arrangement, and performance of all equipment supplied under this section.

B. Environmental Conditions:

1. All equipment including controls and drives specified herein shall be specifically designed to be installed for this service and the environment encountered in this installation, unless noted otherwise.
2. The environment will be moist, and corrosive, exhibiting hydrogen sulfide and other corrosive gases encountered in municipal wastewater treatment plants.
3. All equipment shall be designed and capable of operation outdoors at ambient temperatures of 10°F to 110°F.
4. Equipment shall be compatible with heat tracing and insulation, which will be furnished and installed by the Contractor. The equipment supplier shall design piping systems with ample clearances and material compatibility to accept required heat tracing and insulation. If additional freeze protection beyond heat tracing and insulation is required it shall be furnished by the equipment supplier. The equipment supplier shall coordinate with the Contractor to provide direction on where heat tracing is required, and shall verify that the Contractor has provided adequate heat tracing and insulation during startup activities.

1.8 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to the Contract Documents for specific content requirements and particular requirements for submitting special warranties.
4. Special Equipment Warranty.
    a. The equipment manufacturers shall jointly warrant to the Owner and to the Contractor that all equipment, including all components of the complete assembly furnished by it hereunder, complies in all respects with the design and specifications of these Documents and contains no defects of material or workmanship.
    b. In the event of failure of any part or parts of the equipment during the warranty period due to defects of design, materials, or workmanship; the Contractor shall replace affected part or parts shall be replaced promptly upon notification by the Owner. All replacement parts shall be furnished, delivered, and installed at the expense of the equipment manufacturer.
    c. The warranty period shall begin on the date of the Certification of Substantial Completion for that portion of the project where the equipment was installed.
    d. The warranty period shall be two (2) years, unless otherwise specified. Provisional acceptance of the equipment shall not affect this requirement.
    e. The Contractor shall be responsible for insuring that the manufacturer's special equipment warranty is not voided by acceptance of the terms of purchase agreements between the Contractor and the Manufacturer. In all events, the Contractor will be held ultimately responsible for enforcement of the requirements of this warranty at his expense.
    f. Payment for equipment as "Materials-On-Hand" will not be made until the Owner receives an approved Special Equipment Warranty.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Like items of products furnished and installed shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer’s services, and implement same or similar process instrumentation and control functions.

4. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
5. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
6. Where products are accompanied by the term "as selected," Engineer will make selection.
7. Where products are accompanied by the term "match sample," sample to be matched is Engineer's.
8. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
9. Regulatory Requirements: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
10. Safety Guards:
    a. Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal.
    b. Use 16-gauge or heavier; galvanized steel, aluminum, coated steel and ½-inch mesh expanded steel.
    c. For outdoor installations prevent entrance of rain or dripping water.
11. Electrical Components: Provide Work in accordance with NFPA 70, National Electrical code, and be labeled by a nationally recognized testing laboratory or other agency acceptable to the authority having jurisdiction.
12. Equipment Finish:
    a. Provide manufacturer's standard finish and color, except where specific color is indicted.
    b. If manufacturer does not have a standard color, provide color as approved by Engineer.
13. Special Tools and Accessories: Provide to Owner all special tools and accessories required placing equipment in operation. These include, but not limited to, adequate oil and grease (as required for first servicing of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts required for maintenance.
14. Lubricant: Provide initial lubricant recommended by manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, start-up, and operation until final acceptance by Owner.

B. Fabrication and Manufacture:
1. General Requirements:
    a. Manufacture parts to U.S.A. standard sizes and gauges.
    b. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
    c. Design structural members for anticipated shock and vibratory loads.
    d. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
    e. Modify standard products as necessary to meet performance specifications.
2. Lubrication System Requirements:
    a. Require no more than weekly attention during continuous operation.

b. Convenient and accessible. Oil drains, with bronze or stainless steel valves, and fill-plugs easily accessible from normal operating area or platform. Locate drains to allow convenient collection of oil during changes without removing equipment from its installed position.
c. Provide constant-level oilers or oil level indicators for oil lubrication systems.
d. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

C. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that comply with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Engineer’s sample. Engineer’s decision will be final on whether a proposed product matches.
    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, and textures" or a similar phrase, select a product that complies with other specified requirements.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Engineer will select color, pattern,

density, or texture from manufacturer's product line that does not include premium items.

b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, ENGINER will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Engineer will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Engineer.

B. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

2.3 COMPARABLE PRODUCTS

A. Conditions: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, which it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

2.4 REUSE OF EXISTING MATERIAL

A. Except as specifically indicated or specified, materials and equipment removed from existing facilities shall not be used in the completed Work.
B. For materials and equipment designated for reuse in the Work:
    1. Use special care in removal, handling, storage, and installation to ensure proper function in the completed Work.
    2. Arrange for transportation, storage and handling of the products when offsite storage, restoration, or renovation. All costs associated with this work are the Contractor's responsibility.

2.5 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

A. See applicable sections for specific requirements.
B. Schedule:
    1. Ensure shipment and delivery occurs concurrent with shipment of product.
    2. Transfer to Owner upon acceptance by Contractor of shipment.
C. Packaging and Shipment:
    1. Package and ship items to avoid damage during long term storage in original cartons or in appropriately sized, hinged-cover, wood, plastic or metal boxes.
    2. Prominently display on each package: Part number, consistent with Operation and Maintenance Manual identification system; equipment description, quantity of parts; and equipment manufacturer.
D. Deliver to designation location as directed by Resident Project Representative.

PART 3 - EXECUTION

3.1 WORK IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS

A. When the specification Section requires the Work to be accomplished in accordance with "manufacturer's instructions", obtain and distribute copies of such instructions to parties involved in the installation. Provide two copies to the Resident Project Representative and maintain one set at the Project site.
B. Handle, install, connect, clean, condition and adjust products in strict accordance with the manufacturer's instructions and in conformity with the Contract Documents. Do not omit any preparatory step or installation procedures. In case of conflict between job conditions or Contract Documents with manufacturer's instructions notify Resident Project Representative.
C. Upon completion of installation, obtain Certificate of Installation from manufacturer's representative.

3.2 INSPECTION

A. Inspect products for signs of pitting, rust decay, or other deleterious effects of storage. Do not install products showing such effects. Remove damaged product from Project site and expedite delivery of identical new product. Delays to Work resulting from product damage, which necessitates procurement of new product, will be considered delays within Contractor's control.

3.3 INSTALLATION

A. Drawings show general locations for product installation, unless specially dimensioned.
B. No shimming between machined surfaces is allowed.
C. Install Work in accordance with NECA Standard of Installation, unless otherwise specified.
D. Recoat finish surfaces that are damaged prior to final acceptance of Work.
E. Do not cut or notch any structural member or building surface without specific approval of Engineer.
F. Handle, install, connect, clean, condition, and adjust product in accordance with Contract Documents and manufacturer's instructions.
G. Apply field coating in accordance with Contract Documents.
H. Perform required adjustments, tests, operation checks, and other start-up activities.
I. Fill lubricant reservoirs and replace consumption during testing, start-up, and operation prior to final acceptance of Work by Owner.

3.4 SUPPLEMENTS

A. Sample forms included after "End of Section" are considered part of this Section:
    1. Substitution Request.

END OF SECTION

Advancement of Construction Technology

SUBSTITUTION REQUEST
(After the Bidding Phase)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached - REQUIRED BY ENGINEER

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Engineer: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 43 16.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 43 16.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

_____

_____

_____

_____

_____

_____

SECTION 01 75 25
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements that apply to implementation of commissioning, which includes equipment testing and facility startup according to the manufacturer's instructions and as instructed by the manufacturer's representative.

B. Related Sections:
   1. Division 1 Section 01 43 33 "Manufacturer's Field Services" for information regarding the manufacturer's representative.
   2. Division 1 Section 01 78 23 "Operation and Maintenance Data" for information relating to the operation and maintenance of the equipment and systems.
   3. Division 1 Section 01 79 00 "Demonstration and Training" for information regarding training of the Owner's personnel.
   4. Division 2 through 46 Sections for information on various equipment and systems.

1.3 DEFINITIONS

A. Basis of Design: A document that records concepts, calculations, decisions, and product selections used to meet the Owner's Project requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This normally will be the Engineering Design Report.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

E. Facility: Entire Project, or an agreed-upon portion, includes all of its unit processes.

F. Functional Test: Test or tests in presence of Commissioning Team to demonstrate and confirm that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.

G. Performance Test: Test or tests performed after any required functional test in presence of Commissioning Team, to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.

H. Unit Process: A unit process is a portion of the facility that performs a specific process function, such as screening, aeration, clarification, or pumping.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor:
   1. Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action.
   2. The commissioning team shall consist of, but not be limited to, representatives of Contractor including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the Contractor.
   3. Commissioning Authority: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process.

B. Members Appointed by Owner:
   1. Operation and maintenance personnel.
   2. Engineer and engineering design professionals.

1.5 SUBMITTALS

A. Informational Submittals:
   1. Facility Startup and performance Demonstration Plan.
   2. Functional and performance test results.
   3. Completed Unit Process Startup Form for each unit process.
   4. Completed Facility Performance Demonstration/Certification Form.

1.6 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

A. Develop a written plan, in conjunction with Owner's operations personnel to include the following:
   1. Step-by-step instructions for startup of each unit process and equipment item.
   2. Unit Process Startup Form, as a minimum to include the following:
      a. Description of the process, including equipment numbers and nomenclature of each item of equipment and all included devices.
      b. Detailed procedure for startup of the process, including valves to be opened/closed, order of equipment startup, and related operation information.
      c. Startup requirements for each unit process, including water, power, chemicals, and related requirements.
      d. Space for evaluation comments.
   3. Facility Performance Demonstration/Certification Form, as a minimum include the following:
      a. Description of processes included in the facility startup.
      b. Sequence of process startup to achieve facility startup.
      c. Description of computerized operations, if any, included in the facility.
      d. Contractor certification facility is capable of performing intended function(s), including fully automatic operation.
      e. Signature for Contractor and Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Facility Startup Meeting(s): Schedule to discuss test schedules, test methods, materials, chemicals and liquids required, facilities operations interface, and Owner involvement as described in Division 1 Section 01 31 00 “Project Management and Coordination”.

B. Commissioning Authority: Contractor shall designate the Commissioning Authority responsible for the coordination of the various facility equipment testing and startup activities. The designated person(s) or entity shall be present during startup meetings and available at all times during the testing, startup, and demonstration period.

C. Provide temporary valves, gauges, piping, test equipment, and other materials, tools, and equipment required.

D. Provide subcontractors and manufacturer’s representatives adequate to prevent delays, Schedule ongoing work so as not to interfere with or delay testing, startup, and demonstration.

E. Owner will:
   1. Provide water, power, chemicals and other items required during the Facility Performance Demonstration period, unless otherwise indicated.
   2. Operate process units and facility with support of the Contractor.
   3. Provide labor and materials as required for laboratory analyses.

3.2 EQUIPMENT TESTING

A. Preparation:
   1. Complete installation before testing.
   2. Furnish manufacturer’s representative when required by individual Sections.
   3. Obtain and submit from equipment manufacturer’s representative Manufacturer’s Certificate of Installation Form in accordance with Division 1 Section 01 43 33 “Manufacturer’s Field Services,” when required by individual Sections.
   4. Equipment Test Report Form: Provide a written test report for each item of equipment to be tested, to include the minimum information:
      a. Owner/Project Name.
      b. Equipment or component to be tested.
      c. Date and time of test.
      d. Type of test performed (Functional of Performance).
      e. Test method.
      f. Test conditions. Test results.
      g. Signature spaces for Contractor and Engineer as witness.
   5. Cleaning and Checking: prior to beginning functional testing:
      a. Calibrate testing equipment in accordance with manufacturer’s instructions.
      b. Inspect and clean equipment, devices, components, piping, and structures to ensure they are free of foreign material.
      c. Lubricate equipment in accordance with manufacturer’s instructions.
      d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.

e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
f. Check power supply to electric-powered equipment for correct voltage.
g. Adjust clearances and torque.
h. Test piping for leaks.

6. Ready-to-test determination will be made by Resident Project Representative based on at least the following:
   a. Acceptable Operation and Maintenance Data.
   b. Notification by Contractor of equipment readiness for testing.
   c. Receipt of Manufacturer's Certificate of Installation, when required by individual Sections.
   d. Adequate completion of work adjacent to, or interfacing with equipment to be tested, including items furnished by Owner as applicable.
   e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
   f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
   g. Equipment and electrical identification complete.
   h. Delivery of all spare parts and special tools.
7. Functional Testing:
   a. Comply with the requirements of Division 40 for mechanical equipment and conduct as specified in individual Sections.
   b. Comply with the requirements of Division 26 for electrical equipment and devices and Division 40 for instrumentation systems as applicable.
   c. Notify Resident Project Representative, Owner, and Engineer in writing at least ten (10) days prior to schedule date of testing.
   d. Prepare Equipment Test Report summarizing test method and results.
   e. When, in the opinion of the Engineer, equipment complies with functional requirements, such equipment will be accepted for purposes of advancing to the performance-testing phase. The acceptance will be evidenced by the Engineer's signature as witness on Equipment Test Report.

B. Performance Testing:
1. Conduct as specified in individual Sections.
2. Notify Resident Project Representative, Owner, and Engineer in writing at least ten (10) days prior to schedule date of testing.
3. Performance testing shall not commence until Engineer has accepted equipment as having satisfied functional testing requirements.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and obtaining samples and performance measurements.
6. When, in the opinion of the Engineer, equipment complies with performance requirements, such equipment will be accepted as to conforming to Contract requirements. The acceptance will be evidenced by the Engineer's signature as witness on Equipment Test Report.

3.3 STARTUP OF PROCESSES

A. Prior to process startup, Engineer shall accept equipment within the process as having met functional and performance testing requirements.

B. Startup sequencing of unit processes shall be as chosen by Contractor to meet schedule requirements.

C. Make adjustments, repairs, and corrections necessary to complete unit process startup. Contractor shall replace any spare parts used from stock furnished to Owner.

D. Startup shall be considered complete, when, in the opinion of the Engineer, unit process has operated in a satisfactorily manner intended for thirty (30) continuous days without significant interruption. This period is in addition to the functional and performance test periods.

E. Significant interruption: May include any of the following:
   1. Failure of Contractor to provide and maintain qualified onsite startup personnel as schedule.
   2. Failure to meet specified functional operation for more than two consecutive hours.
   3. Failure of any critical equipment or unit process that is not satisfactorily corrected within five hours after failure.
   4. Failure of any non-critical equipment or unit process that is not satisfactorily corrected within eight hours after failure.
   5. As determined by Engineer.

F. A significant interruption will require startup, then in progress, to be stopped. After corrections are made, startup test period to start from the beginning again.

3.4 SUPPLEMENTS

A. Supplements listed below following “End of Section” are part of this Section:
   1. Unit Process Startup Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

OWNER: _____ **PROJECT:** _____

Unit Process Description (Include description and equipment number of all equipment and devices):

_____

_____

_____

_____

_____

_____

_____

Startup Procedure (Described procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

_____

_____

_____

_____

_____

_____

_____

_____

_____

Startup Requirements (Water, power, chemicals, etc):

_____

_____

Evaluation Comments: _____

_____

_____

_____

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, mixing and transporting equipment, and incidentals necessary to proportion, mix, transport, place, consolidate, finish, and cure concrete in the structure.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, and other Pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01 30 00 “Project Documentation,” and shall include:
   1. Shop Drawings:
      a. Mix design: For each concrete mix, complete the form “Concrete Mix Design” and one of the following forms: “Documentation of Required Average Strength – Field Strength Test Record” or “Documentation of Average Strength – Trial Mixtures.”
      b. Submit a schedule to the OWNER’s Representative, which shows the sequence of concrete placements.
   2. Certified Test Reports:
      a. Materials used in the trial mix design.
      b. Aggregate, conforming to ASTM C33, including the test reports for soundness and abrasion resistance.
      c. Aggregate:
         1) Verification that aggregate is not “potentially reactive,” per ASTM C289; or
         2) A cement chemical analysis indicating that the total alkali content is acceptable, per Paragraph 2.2.A.
      d. 7-day and 28-day compressive strength tests results.
         1) When more than fifteen (15) 28-day compressive tests results are available from the current Project for a given class of concrete, include the 15-test running average compressive strength, versus the required average compressive strength (based on the previous 15 tests) in graphical form.
   3. Record Data:
      a. Manufacturer’s literature on specified materials.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications:

1. A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
2. Manufacturer must be certified according to the National Ready-Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

C. Testing Agency Qualifications:
1. An independent testing agency, acceptable to authorities having jurisdiction and the ENGINEER, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated.
2. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver cement in bulk or bags which are plainly marked with the brand and manufacturer's name. Immediately upon receipt, store cement in a dry, weather-tight, and properly ventilated structure which excludes moisture. Storage facilities shall permit easy access for inspection and identification. Cement not stored in accordance with the requirements shall not be used.

B. Sufficient cement shall be in storage to complete placement of concrete started. In order that cement may not become unduly aged after delivery, maintain records of delivery dates. Use cement which has been stored at the Site for 60 days or more before using cement of lesser age. No cement shall be used which is lumped, caked, stored more than 90 days, or whose temperature exceeds 170°F.

1.6 STANDARDS

A. Mixing, sampling, placing, curing, and testing of concrete, and the materials used shall be in compliance with the latest revisions of the following standards, unless otherwise noted in the Contract Documents. The CONTRACTOR shall maintain one copy of each of the applicable standards at the construction field office.
1. American Society for Testing and Materials (ASTM) Standards:

ASTM C31	Standard Practice for of Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Specification Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Standard Specification Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C87	Standard Specification Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C94	Standard Specification of Ready Mixed Concrete
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates

ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C156	Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C191	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C289	Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
ASTM C293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
ASTM C309	Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C579	Standard Test Methods for Compressive Strength of Chemical Resistant Mortars, Grouts, Monolithic Surfacings,and Polymer Concretes
ASTM C580	Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical Resistant Mortars, Grouts, Monolithic Surfacings,and Polymer Concretes
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C806	Standard Test Method for Restrained Expansion of Expansive Cement Mortar
ASTM C827	Standard Test Method for Change in Height at Early Stages of Cylindrical Specimens of Cementitious Mixtures
ASTM C845	Standard Specification for Expansive Hydraulic Cement
ASTM C878	Standard Test Method for Restrained Expansion of Shrinkage Compensating Concrete
ASTM C881	Standard Specification for Epoxy Resin Base Bonding Systems for Concrete
ASTM C1240	Standard Specification for Silica Fume used in Cementitious Mixtures
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D638	Standard Test Method for Tensile Properties of Plastics

ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D994	Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2240	Standard Test Method for Rubber Property Durometer Hardness
ASTM D6690-07	Standard Specification for Joint and Crack Sealant, Hot Applied, for Concrete and Asphalt Pavements
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials

2. American Concrete Institute (ACI) Standards:

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavy-weight, and Mass Concrete
ACI 214	Recommended Practice for Evaluation of Strength Test Results
ACI 223	Standard Practice for Use of Shrinkage Compensating Concrete
ACI 301	Specification for Structural Concrete for Buildings
ACI 304	Guide for Measuring, Mixing, Transporting & Placing Concrete
ACI 304.2R	Placing Concrete by Pumping Methods
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308	Standard Practice for Curing Concrete
ACI 309	Guide for Consolidation of Concrete
ACI 318	Building Code Requirements for Reinforced Concrete

3. Corps of Engineers, Department of the Army Specification:

CRD C621 83	Corps of Engineers Specification for Non-Shrink Grout

4. Federal Specification:

TT S 00227E	Type II, Class A or B, Expansion Joint Sealant

5. Concrete Plant Manufacturers Bureau (CPMB) Standards:

CPMB	Concrete Plant Standards

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 Articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONCRETE MATERIALS

A. Cementitious Material; General: If the fine and/or coarse aggregates test "Potentially Reactive", in accordance with ASTM C289, then a low alkali cementitious material shall be used. A low alkali cementitious material shall be such that the total alkali content calculated as the percentage of sodium oxide (Na_2O) plus 0.658 times the percentage of potassium oxide (K_2O) shall not exceed 0.6 percent of the total cementitious material content.

B. Cement; Type: Type I/II or II Portland cement, conforming to ASTM C150; used for all concrete, unless noted otherwise.

C. Fly Ash/Pozzolans: Conforming to ASTM C618, Class C fly ash; used in all classes of concrete. A supplier's certificate of the analysis and composition of the fly ash shall be supplied.

D. Coarse Aggregate:
1. Crushed stone or gravel conforming to ASTM C33, in the gradation size specified.
2. For gradation size number 467, a maximum aggregate size of 1-1/2 inches is:

Sieve Size	Percent Retained	Percent Passing
2"	0	100
1-1/2"	0-5	95-100
3/4"	30-65	35-70
3/8"	70-90	10-30
No. 4	95-100	0-5

3. For gradation size number 57, the maximum aggregate size of 1 inch is:

Sieve Size	Percent Retained	Percent Passing
1-1/2"	0	100
1"	0-5	95-100

Sieve Size	Percent Retained	Percent Passing
1/2”	40-75	25-60
No. 4	90-100	0-10
No. 8	95-100	0-5

4. For gradation size number 67, the maximum aggregate size of 3/4 inch is:

Sieve Size	Percent Retained	Percent Passing
1”	0	100
3/4”	0-10	90-100
3/8”	45-80	20-55
No. 4	90-100	10-10
No. 8	90-100	0-5

5. For gradation size number 8, the maximum aggregate size of 3/8 inch is:

Sieve Size	Percent Retained	Percent Passing
1”	0	100
3/8”	0-15	85-100
No. 4	70-90	10-30
No. 8	90-100	0-10
No. 16	95-100	0-5

E. Fine Aggregate:

1. Washed and screened natural sands or sands manufactured by crushing stones; conforming to ASTM C33. The gradation in ASTM C33 for air entrained concrete is:

Sieve Size	Percent Retained	Percent Passing
3/8”	0	100
#4	0-5	95-100
#8	0-20	80-100
#16	15-50	50-85
#30	40-75	25-60
#50	70-90	10-30

2. Fine aggregate shall have not more than 45 percent retained between any two consecutive sieves. Its fineness modulus, as defined in ASTM C125, shall be not less than 2.3, nor more than 3.1.

F. Water: Potable and complying with ASTM C94.

2.3 ADMIXTURES

A. Air-Entraining Admixture: Conforming to ASTM C260. The total average air content shall be in accordance with recommendations of ACI 211.1; 4.5 percent plus or minus 1.5 percent for 1-1/2-inch maximum size aggregate.

B. Water Reducing Admixtures: Conforming to ASTM C494; Types “A” or “D” only; accurately measured and added to the mix according to the manufacturer’s recommendations.

C. Set Retarding Admixtures: Conforming to ASTM C494; Types “B” and “D” only; accurately measured and added to the mix in according to the manufacturer’s recommendations.

Water-Reducing Admixtures - High Range (HRWR): High-Range Water Reducer shall comply with ASTM C494, Type F or G. HRWR shall be accurately measured in accordance with the manufacturer’s recommendations. HRWR shall be added to the concrete mix at the concrete batch plant. HRWR may not be added at placement site, except to re-dose a batch and only after approval of the HRWR manufacturer. The high-range water-reducing admixture shall be able to maintain the plasticity range without significant loss of slump or rise in concrete temperature for 2 hours. With the use of these admixtures, slump limit shall be between 7 and 9 inches, unless otherwise authorized by the manufacturer and approved by the ENGINEER. Other admixtures may only be used with the HRWR if approved by the HRWR manufacturer and ENGINEER. A representative of the HRWR manufacturer shall be present during any large placement, placement of slabs, or during times of unusual circumstance which may require changes to the product formulation.

1. Manufacturers:
    a. Master Builders, Inc.
    b. W. R. Grace & Co.
    c. Sika Corporation.

2.4 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes. Unless indicated otherwise, provide the following configurations.

1. Construction Joints:
    a. Profile: Ribbed without center bulb.
    b. Width: 6 inches.
    c. Minimum thickness: 3/8 inch.
2. Expansion Joint:
    a. Profile: Ribbed with center bulb.
    b. Width: 9 inches.
    c. Minimum thickness: 3/8 inch.

B. Manufacturers:

1. PVC Waterstops:
    a. Greenstreak.
    b. Meadows: W. R. Meadows, Inc.
    c. Murphy: Paul Murphy Plastics Co.
    d. Progress Unlimited Inc.
    e. Sternson Group.
    f. Tamms Industries Co.; Div. of LaPorte Construction Chemicals North America, Inc.
    g. Vinylex Corporation.

h. Westec Barrier Technologies; Div. of Western Textile Products, Inc.

C. Self-Expanding Strip Waterstops (Hydrophilic): Self-expanding strip waterstops shall be used only where specifically indicated. Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.
   1. Products:
      a. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.
      b. Adeka Ultra Seal; Mitsubishi International Corporation.
      c. Hydrotite; Greenstreak.

2.5 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Available Products:
      a. Fortifiber Corporation; Moistop Ultra A.
      b. Raven Industries Inc.; Vapor Block 15.
      c. Reef Industries, Inc.; Griffolyn Type-105.
      d. Stego Wrap (15-mil) Vapor Barrier; Stego Industries, LLC.

2.6 CURING MATERIALS

A. Sheet Curing Material: Conforming to ASTM C171.
   1. Waterproof paper.
   2. Polyethylene film.
   3. White burlap - polyethylene film.

B. Membrane Curing Compounds: Membrane curing compound conforming to ASTM C309; having a color to indicate coverage when applied; non-staining; applied according to the manufacturer's recommendations. No curing compound shall be used on walls which are to receive a plaster mix finish. When tested according to ASTM C156, the curing compound shall provide a film which has retained, within the specimen, the following percentages of moisture when the curing compound was applied:
   1. At least 97 percent at the end of 24 hours.
   2. At least 95 percent at the end of 3 days.
   3. At least 91 percent at the end of 7 days.

C. Concrete Curing and Sealing Compound: Where a sealer is necessary, use a concrete curing and sealing compound. Application of this product shall be in accordance with the manufacturer's recommendations.
   1. Interior Concrete Surfaces: Sonneborn Kure-N-Seal W, by BASF The Chemical Company.
   2. Exterior Concrete Surfaces: Sonneborn Kure 1315, by BASF The Chemical Company.

D. Finishing Aid: Spraying material designed to form a monomolecular film on fresh concrete that reduces the rate of evaporation of surface moisture prior to finishing; conforming to Confilm, as manufactured by Master Builders, Inc. This material is not a curing compound. Concrete must be cured as specified.

2.7 RELATED MATERIALS

A. Joint Materials for Water-Retaining Structures:

1. Pre-molded, resilient, non-bituminous expansion joint filler conforming to ASTM D1752, Type "II", in the thickness specified.
2. Joint sealer conforming to ASTM D6690.
3. Expansion joint sealant for non-potable water shall be a two-component, non-sag, polysulfide-base, elastomeric sealing compound. The material shall conform to Federal Specification TT S 00227E, Type "II", Class B; installed according to the manufacturer's recommendations. Backing material for sealant shall be a rod of a diameter and composition recommended by the sealant manufacturer.
4. Expansion joint sealant for potable water shall be a two-component, non-sag, polysulfide sealant containing no lead or mercury; conforming to Fed. Spec. TT S 00227E, Type "II", Class A; applied according to the manufacturer's specifications. Backing material for sealant shall be a rod of a diameter and composition recommended by the sealant manufacturer.
5. Where surface is to receive a swept-in grout topping, a 3-inch wide, 1-mil polyethylene strip shall be placed above the joint sealant and held in place with 1-inch wide polyethylene tape, spaced at 12-inch centers (maximum).

B. Joint Materials for Non-Water-Retaining Structures: Bituminous-type, preformed, expansion joint filler; conforming to ASTM D994.

C. Bonding Agents: Install according to the manufacturer's recommendations and written instructions.
1. Products:
a. Sika Armatec 110 EpoCem by Sika Corporation.
b. Sikadur 32, Hi-Mod by Sika Corporation.

D. Concrete Grout:
1. Conform to requirement for concrete, except as specified herein. Proportion with Type I/II or II cement, coarse and fine aggregates, water, water-reducing admixture, and air-entraining agent to produce a mix having an average strength of 3500 psi at 28 days (2500-psi nominal strength). Coarse aggregate size shall be 3/8-inch, maximum. Slump shall not exceed 5 inches. Minimum cement content shall be 540 lbs. per cubic yard and maximum water-to-cement ratio shall be 0.45.
2. Add synthetic reinforcing fibers, as specified in Section 0321 00 "Reinforcing Steel," to the concrete grout mix at the rate of 1.5 lbs. of fibers per cubic yard of grout. Add fibers from the manufacturer's pre-measured bags and according to the manufacturer's recommendations to ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Non-Shrink Grout:
1. General: Non-shrink grout for grouting of pump, motor, and equipment baseplates or bedplates, column baseplates, other miscellaneous baseplates, piping block outs and other uses of grout. Grout shall meet the following requirements, as verified by independent laboratory tests:
a. No shrinkage from the time of placement, or expansion after set, under ASTM C827 and CRD C621 83 (Corps of Engineers). When non shrink grouts are tested under CRD C621 83, the grout shall be tested in a fluid state. A fluid state shall be defined as flowing through a flow cone at a rate of 20 seconds, plus or minus 5 seconds.
b. An initial set time of not less than 45 minutes under ASTM C191.

2. Non-Shrink, Non-Metallic Grout: Pre-mixed, non-staining, non-shrink grout; minimum 28-day compressive strength of 5000 psi.
    a. Do not use for vibrating equipment.
    b. Products:
        1) Masterflow 713 Plus by BASF The Chemical Company.
        2) Five Star Grout by Five Star Products, Inc.
        3) SikaGrout 212 by Sika Corporation.
3. Non-Shrink, Epoxy Structural Grouts: Furnished in two components from the factory and mixed on the Site; conforming to ASTM C579, ASTM C580, and ASTM C827; chemical resistant, water resistant and a minimum 7-day compressive strength of 12,000 psi.
    a. Use for vibrating equipment.
    b. Products:
        1) Sikadur 42, Grout-Pak by Sika Corporation.
        2) Five Star HP Epoxy Grout by Five Star Products, Inc.
        3) Masterflow 648 CP by BASF The Chemical Company.

F. Normal Shrinkage Grout: 1 part Portland cement, Type I, to 3 parts of clean, first quality sand; proportioning on a volumetric basis; used for non-structural applications for grouting areas as shown on the Drawings which do not require non-shrink grout.

G. Foundation Waterproofing: Thoroseal Foundation Coating as manufactured by Thoro Systems Products. Foundation coating shall be used only on the exterior of concrete walls not exposed to view where indicated on the Drawings.

H. Zinc Rich Primer: Aluminum surfaces which contact or are embedded in concrete shall be coated with zinc rich primer. Primer shall be Tneme-Zinc.

2.8 REPAIR MATERIALS

A. Structural Concrete Repair Material: Non-shrink, non-slump, non-metallic, quick setting patching mortar; as approved by the manufacturer for each application and applied accordance with the manufacturer's recommendations.
    1. Products:
        a. Sikatop 122 Plus by Sika Corporation (horizontal applications).
        b. Sikatop 123 Plus by Sika Corporation (vertical applications).
        c. Five Star Structural Concrete by Five Star Products, Inc.

2.9 CONCRETE MIXTURES

A. Design Criteria:
    1. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, admixtures and water, as specified. All Class A and C concrete shall include high range water reducer (HRWR).
    2. ACI 211.1 shall be the basis for selecting the proportions for concrete made with aggregates of normal and high density and of workability suitable for usual cast in place structures.
    3. The design of the concrete shall be consistent with the minimum requirements of strength and proportions stated herein and in accordance with ACI Standard 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete," subject to maximum water cement ratio, minimum cement content and minimum strengths specified.

4. The workability of any mix shall be as required for the specific placing conditions and the method of placement. The concrete shall have the ability to be worked readily into corners and around reinforcing steel without the segregation of materials or the collection of free water on the surface. Compliance with specified slump limitations shall not necessarily designate a satisfactory mix.
5. In no case shall the amount of coarse material produce harshness in placing or honeycombing in the structure, when forms are removed.
6. The maximum amount of coarse aggregate (dry loose volume) per cubic foot of finished concrete shall not exceed 0.82 cubic feet.
7. The maximum amount of water includes the water in the aggregate, with the aggregates in a saturated, surface-dry condition.
8. The maximum water content shall be the amount added at the mixer, plus the free water in the aggregate, and minus the absorption of the aggregate based on a 30-minute absorption period. No allowance shall be made for the evaporation of water after batching. If additional water is required to obtain the desired slump, a compensating amount of cement shall also be added. In no case shall the maximum water cement ratio exceed the specified maximum or that of the approved mix design. No additional compensation shall be made for additional cement.
9. If fly ash is to be used in place of cement, no more than 20 percent of the cement may be replaced.
10. Concrete of 3000 psi or stronger shall contain air entraining admixtures with the exception of drilled shafts. However, drilled shafts shall also contain air-entraining admixtures if fly ash is used or if placed underwater.
11. When job conditions dictate, water-reducing and set-controlling admixtures may be used. Only specified admixtures shall be used. Admixtures shall be batched at the batch plant.
12. Concrete shall be capable of developing two-thirds of the required 28-day compressive strength in 7 days.

B. Concrete Classifications:

Class	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (inches)	Max. Water: Cement Ratio	Max. Slump (inches)*	Min. Sacks of Cement Per Cubic Yard **
A	4000	1.5*** Size No. 467	0.45	4	5.75
B	3000	1.5 Size No. 467	0.47	4	5.75
C	4000	1.0 Size No. 57	0.45	5	6.25
D	5000	0.75 Size No. 67	0.47	5	6.75
E	1500	1.5 Size No. 467	0.70	-	4.0
F	4000	0.375 Size No. 8	0.44	4	6.00
* Maximum slump with high range water reducing admixture may be increased to 7" – 9". High range water reducing admixture shall be used on all walls.					
** Provide one additional sack of cement per cubic yard if concrete must be deposited in water.					
*** Maximum aggregate size may be reduced to one inch if six sacks of cement per cubic yard are used.					
**** For precast concrete, precast panels, and hollow core panels, the maximum aggregate size shall be as required by the manufacturer.					

C. Concrete Usage:

Class	Usage
Class A Use	All reinforced concrete unless otherwise specified
Class B Use	Sidewalks, Curbs
Class C Use	Pumped Concrete, Drilled Shafts, Thin Wall Sections
Class D Use	Precast Concrete, Precast Panels, and Hollow-Core Panels
Class E Use	Cradling, Blocking, Foundation Seal Slab, Lean Concrete Backfill
Class F Use	Stair Pans and Landings

D. Required Average Compressive Strength:

1. All concrete is required to have an average compressive strength greater than the specified strength. The required average compressive strength shall be established according to the requirements of ACI 301, 4.2.3.3.
2. Standard Deviation: If the production facility has records of field tests performed within the past 12 months and spanning a period of not less than 60 calendar days for a class of concrete within 1000 psi of that specified for the Work, calculate a standard deviation and establish the required average strength fcr' in accordance with ACI 301,

4.2.3.2 and 4.2.3.3.a. If field test records are not available, select the required average strength from ACI 301, Table 4.2.3.3.b.

E. Documentation of Required Average Compressive Strength:
   1. Documentation indicating the proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength, shall consist of field strength records or trial mixture.
   2. Field Strength Records: Document field strength records according to ACI 301, 4.2.3.4.a and including the following:
      a. Field test data shall not be older than 1 year.
      b. If field test data are available and represent a single group of at least 10 consecutive strength tests for one mixture, using the same materials, under the same conditions, and encompassing a period of not less than 60 days, verify that the average of the field test results equals or exceeds fcr' . Submit for acceptance the mixture proportions along with the field test data.
      c. If the field test data represent two groups of compressive strength tests for two mixtures, plot the average strength of each group versus the water-cementitious materials ratio of the corresponding mixture proportions and interpolate between them to establish the required mixture proportions for fcr'.
   3. Trial Mixtures:
      a. Establish trial mixture proportions according to ACI 301, 4.2.3.4.b and including the following.
         1) Make at least three trial mixtures complying with performance and design requirements. Each trial mixture shall have a different cementitious material content. Select water-cementitious materials ratios that will produce a range of compressive strengths encompassing the required average compressive strength fcr'.
         2) Submit a plot of a curve showing the relationship between water-cementitious materials ratio and compressive strength.
         3) Establish mixture proportions so that the maximum water-cementitious materials ratio is not exceeded when the slump is at the maximum specified.
      b. Laboratory Samples shall be taken in accordance with the trial mix designs for laboratory testing purposes.
      c. The fresh concrete shall be tested for Slump (ASTM C143) and Air Content (ASTM C173 and ASTM C231). Strength test specimens shall be made, cured and tested for 7-day and 28-day strength in accordance with ASTM C192, ASTM C39, and ASTM C293.
      d. Suitable facilities shall be provided for readily obtaining representative Samples of aggregate from each of the weigh batchers for test purposes and for obtaining representative Samples of concrete for uniformity tests. The necessary platforms, tools, and equipment for obtaining Samples shall be furnished. Aggregates shall be tested in accordance with ASTM C289.
      e. The cement contents specified are minimum values. If additional quantities are required to obtain the specified strengths, supply the cement at no additional cost to the OWNER.
      f. A trial mix shall be designed by an independent testing laboratory, retained and paid by the Contractor and approved by the OWNER. The testing laboratory shall submit verification that the materials and proportions of the trial concrete mix design meet the requirements of the Specifications.

g. From these trial mix tests, the ratios between 7-day and 28-day strengths shall be established. The 7-day strength which corresponds to the required 28-day strength shall be determined.

h. The final results of the trial mix design shall be submitted to the ENGINEER at least 10 days prior to the scheduled beginning of concrete placement and shall be approved by the ENGINEER prior to the placement of any concrete.

4. Revisions to concrete mixtures:

a. When less than 15 compressive strength tests results for a given class of concrete are available from the current Project:

1) If any of the If any of the following criteria are met, take immediate steps to increase average compressive strength of the concrete.

a) A 7-day compressive strength test result multiplied by 1.5 falls below the required 28-day compressive strength.

b) A 28-day compressive strength tests result is deemed not satisfactory.

b. When at least 15 compressive strength test results for a given class of concrete become available from the current Project:

1) Calculate the actual average compressive strength, standard deviation and required average compressive strength using the previous 15 consecutive strength tests. Submit results in graphical form with each 28-day test result for that class of concrete.

2) If any of the following criteria are met, take immediate steps to increase average compressive strength of the concrete.

a) A 7-day compressive strength test result multiplied by the average job-to-date ratio of 7-day to 28-day compressive strength falls below the required 28-day compressive strength.

b) A 28-day compressive strength tests result is deemed not satisfactory.

c) The average compressive strength falls below the required average compressive strength.

c. When revisions to the mix design are required, notify the ENGINEER in writing of the corrective actions taken.

2.10 OFF-SITE BATCH PLANT

A. Batch plants shall be an established concrete batching facility meeting the requirements of the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau.

2.11 CONCRETE MIXING

A. Mixers may be stationary, truck, or paving mixers of approved design. They shall be capable of combining the materials into a uniform mixture and of discharging without mixture segregation. Stationary and paving mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixers or mixing plant shall include a device for automatically counting the total number of batches of concrete mixed. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer on the name plate.

B. The mixing time for stationary mixers shall be based upon the mixer's ability to produce uniform concrete throughout the batch and from batch to batch. For guidance purposes, the manufacturer's recommendations, or 1 minute for 1 cubic yard plus 1/4 minute for each

additional cubic yard may be used. Final mixing time shall be based on mixer performance. Mixers shall not be charged in excess of the capacity specified by the manufacturer.

C. When a stationary mixer is used for partial mixing of the concrete (shrink mixed), the stationary mixing time may be reduced to the minimum necessary to intermingle the ingredients (about 30 seconds).

D. When a truck mixer is used, either for complete mixing (transit-mixed) or to finish the partial mixing in a stationary mixer and in the absence of uniformity test data, each batch of concrete shall be mixed not less than 70 nor more than 100 revolutions of the drum, at the rate of rotation designated by the manufacturer of the equipment as mixing speed. If the batch is at least 1/2 cubic yard less than the rated capacity, in the absence of uniformity test data, the number of revolutions at mixing speed may be reduced to no less than 50. Additional mixing shall be performed at the speed designated by the manufacturer of the equipment as agitating speed. When necessary for proper control of the concrete, mixing of transit-mixed concrete shall not be permitted until the truck mixer is at the Site of the concrete placement. Truck mixers shall be equipped with accurate revolution counters.

E. Paving mixers may be either single compartment drum or multiple compartment drum type. A sled or box of suitable size shall be attached to the mixer under the bucket to catch any concrete spillage that may occur when the mixer is discharging concrete into the bucket. Multiple compartment drum paving mixers shall be properly synchronized. The mixing time shall be determined by time required to transfer the concrete between compartments of the drum.

F. Vehicles used in transporting materials from the batching plant to the paving mixers shall have bodies or compartments of adequate capacity to carry the materials and to deliver each batch, separated and intact, to the mixer. Cement shall be transported from the batching plant to the mixers in separate compartments which are equipped with windproof and rain proof covers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Notify the OWNER's representative upon completion of various portions of the work required for placing concrete, so that inspection may be made as early as possible. Keep the OWNER's representative informed of the anticipated concrete placing schedules.

B. All items, including lines and grades, forms, waterstops, reinforcing, inserts, piping, electrical, plumbing and the Contractor's concreting materials and equipment shall be in compliance with the Contract Documents before proceeding.

C. Do not place any concrete until formwork and the placing reinforcement in that unit is complete. Place no concrete before the completion of all adjacent operations which might prove detrimental to the concrete.

D. Brilliantly light the Site so that all operations are plainly visible when concrete mixing, placing, and finishing, continues after daylight. Whenever possible, concrete finishing shall be completed in daylight hours.

E. When placing concrete, the forms shall be clean and entirely free from all chips, dirt, sawdust and other extraneous matter. Forms for slab, beam and girder construction shall not have tie wire cuttings, nails, or any other matter which would mar the appearance of

the finished construction. Clean forms and keep them free of any foreign matter during concrete placing.

F. The concrete shall be mixed in quantities required for immediate use. Any concrete which is not in place within the time limits specified shall not be used. Concrete shall not be re-tempered.

G. Concrete shall not be placed if impending weather conditions would impair the quality of the finished Work.

H. Unless otherwise provided, the following requirements shall govern the time sequence on which construction operations shall be carried.
   1. Forms for walls or columns shall not be erected on concrete footings until the concrete in the footing has cured for at least 2 curing days. Concrete may be placed in a wall or column as soon as the forms and reinforcing steel placements are approved.
   2. Steel beams or forms and falsework for superstructures shall not be erected on concrete substructures until the substructure concrete has cured for at least 4 curing days. Falsework required for superstructures shall not be erected until the substructure has cured for 4 curing days, and shall not be removed until the superstructure has cured.

I. Place grout where indicated or specified over cured concrete which has attained its specified design strength unless otherwise approved by the ENGINEER.

3.2 EMBEDDED ITEMS

A. Where aluminum anchors, aluminum shapes, or aluminum electrical conduits are embedded in concrete, paint aluminum contact surfaces with zinc rich primer. Allow the paint to thoroughly dry before placing the aluminum in contact with the concrete.

B. Paint steel or other ferrous metal to be mounted on or placed in contact with dry/cured concrete, and coat in accordance with Section 09 91 00 prior to installation.

3.3 VAPOR RETARDERS

A. Place, protect, and repair vapor-retarder sheets according to ASTM E1643 and manufacturer's written instructions.

B. Granular fill below the vapor retarder shall be smoothed and free of protrusions that might damage or rupture the polyethylene film. Completely cover porous fill with film. Lap film not less than six inches at all joints, with the top placed in the direction of concrete spreading. Use pressure-sensitive tape at all laps of vapor barrier. Lap reinforcement directly over film before placing concrete, taking precautions to prevent film punctures. Carefully cut film around pipes and wiring outlets, and then apply pressure sensitive tape around these protrusions to insure maximum barrier effectiveness.

3.4 JOINTS

A. Expansion Joints and Devices:
   1. Workmanship: Exercise careful workmanship in joint construction to separate the concrete sections by an open joint or by the joint materials, and make the joints true to the outline indicated.
   2. Expansion Joints: Construct expansion joints and devices to provide expansion and contraction. Construct joints which are to be left open or filled with poured joint

material with forms which are adaptable for loosening or early removal. In order to avoid jamming by the expansion action of the concrete and the consequent likelihood of injuring adjacent concrete, remove or loosen these forms as soon as possible after the concrete has initially set. Make provisions for loosening the forms to permit free concrete expansion without requiring full removal.

3. Armored Joints: Carefully construct armored joints to avoid defective anchorage of the steel and porous or honeycombed concrete adjacent to same. Anchor pre-molded materials to the concrete on one side of the joint with approved adhesive. Anchor so that the material does not fall out of the joint.

B. Construction Joints:

1. Construction joints are formed by placing plastic concrete in direct contact with concrete which has attained its initial set. When concrete is specified as monolithic, the term shall be interpreted as the manner and sequence of concrete placement so that construction joints do not occur.
    a. Unless noted otherwise, the maximum horizontal spacing of construction joints shall be 40 feet.
    b. For slabs on grade, the maximum spacing between two construction joints or between a construction joint and a control joint shall be 15 feet, unless noted otherwise.
    c. Unless noted otherwise or approved by the ENGINEER, the maximum vertical spacing of construction joints shall be 15 feet. If not detailed on the Drawings, construction joint details and locations shall be submitted to the ENGINEER for approval.
2. Additional horizontal and vertical construction joints, when submitted and approved by the ENGINEER, may have an impact on reinforcing details. Revise reinforcing details to reflect additional joints.
3. Unless otherwise provided, construction joints shall be square and normal to the forms. Provide bulkheads in the forms for all joints except horizontal joints.
4. At the proper time, clean horizontal construction joints for receiving the succeeding lift using air water cutting. The surface shall be exposed sound, clean aggregate. The air pressure supply to the jet shall be approximately 100 lb. per square inch, and the water pressure sufficient to bring the water into effective influence of the air pressure. After cutting, wash the surface until there is no trace of cloudiness in the wash water.
5. In areas where air water cutting cannot be satisfactorily accomplished, or in areas where it is undesirable to disturb the surface of the concrete before it has hardened, prepare the surface for receiving the next lift by wet sand blasting to immediately remove all laitance and unsound concrete prior to placing of the next lift. Thoroughly wash the surface of the concrete after sand blasting to remove all loose material.
6. Provide construction joints with concrete keyways or roughened surface without keyway if indicated on the Drawings. Unless indicated otherwise, provide joints perpendicular to main reinforcement. Continue reinforcing steel with a minimum of lap splice length through the joint as indicated on the Drawings. Provide waterstops in wall and slab construction joints in liquid retaining structures, below grade structures and at other locations shown on the Drawings. The method of forming keys in keyed joints shall permit the easy removal of forms without chipping, breaking, or damaging the concrete. The surface of the construction joint without keyway shall be uniformly roughened to full amplitude (distance between high and low points and side to side) of ¼-in to expose a fresh face.

C. Existing Hardened Concrete: Where new concrete or grout is to be placed in contact with existing hardened concrete, texture the existing surface by chipping or other means so that an irregular surface having a height variance of not less than 1/4 inch is created. The existing concrete shall then be coated with a bonding agent and new concrete or grout placed.

3.5 WATERSTOPS

A. PVC Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work.
   1. At formed surfaces, a split form shall be used. The split form shall have a tight fit which prevents misalignment and concrete leakage.
   2. The embedded flange of the waterstop must be secured prior to concrete placement. The flange shall be secured at 12 inches on-center by factory installed hog rings or grommets at the outermost rib. Never place nails or screws through the body of the waterstop.
   3. All fittings and changes in direction shall be factory fabricated. Only straight butt splices shall be made in the field. Field splices shall be according to the manufacturer's written instructions and as follows:
      a. Cut adjoining ends square to form matching edges.
      b. Uniformly melt the ends at 380 F using a thermostatically controlled, Teflon coated splicing iron.
      c. When a 1/8-inch diameter melt bead develops on each waterstop end, remove the splicing iron and firmly press the two ends together in proper alignment. Hold until the material has fused and cooled. Allow the splice to cool naturally; do not quench.

B. Self-Expanding Strip Waterstops:
   1. Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place.
   2. Install in longest lengths practicable.

3.6 CONCRETE PLACEMENT

A. Cold Weather:
   1. If air temperature has fallen to, or is expected to fall below 40 F during the protection period (a minimum of 48 hours unless longer time frame is recommended by ACI 306R), then cold weather concreting shall be performed in accordance with ACI 306R.
   2. In cases where the temperature drops below 40 F after the concreting operations have been started, sufficient canvas and framework or other type of housing shall be furnished to enclose and protect the structure, in accordance with the requirements of ACI 306R. Sufficient heating apparatus to provide heat shall be supplied, and heating source and protection from combustion gas shall be in accordance with ACI 306R. The concrete shall be protected when placed under all weather conditions. Should concrete placed under such conditions prove unsatisfactory, remove and replace the concrete at no cost to the OWNER.
   3. When the air temperature is above 30 F:

a. The minimum concrete temperature at the time of mixing shall be 60 F unless other requirements of ACI 306R are met, which may allow for a lower mix temperature.
b. The minimum concrete temperature at the time of placement and during the protection period shall be 55 F unless other requirements of ACI 306R are met, which may allow for a lower temperature.

4. The means used to heat a concrete mix shall be in accordance with ACI 306R.
5. Salts, chemicals, or other foreign materials shall not be mixed with the concrete to preventing freezing. Calcium chloride is not permitted.

B. Hot Weather:

1. Hot weather is defined as any combination of high air temperature, low relative humidity and wind velocity that impairs the quality of the concrete. Hot weather concreting shall be in accordance with ACI 305R. Concrete shall be placed in the forms without the addition of any more water than that required by the design (slump). No excess water shall be added on the concrete surface for finishing. Control of initial set of the concrete and extending the time for finishing operations may be accomplished with the use of approved water reducing and set retarding admixture, as specified.
2. Maximum time intervals between the addition of mixing water and/or cement to the batch, and the placing of concrete in the forms shall not exceed the following (excluding HRWR admixture use):

Concrete Temperature	**Maximum time From Water Batch to Placement**
Non-Agitated Concrete	
Up to 80 F	30 Minutes
Over 80 F	15 Minutes
Agitated Concrete	
Up to 75 F	90 Minutes
75 F to 89 F	60 Minutes

a. The use of an approved set-retarding admixture will permit the extension of the above time maximums by 30 minutes, for agitated concrete only.
b. The use of an approved high range water reducing (HRWR) admixture will allow placement time extensions as determined by the manufacturer.

3. The maximum temperature of concrete shall not exceed 90 F at the time the concrete is placed. The temperatures of the mixing water shall be reduced by the use of chilled water or ice.
4. The maximum temperature of concrete with high range water reducing admixture shall not exceed 100 F at the time concrete is placed.
5. Under extreme heat, wind, or humidity conditions, concreting operations may be suspended if the quality of the concrete being placed is not acceptable.

C. Handling and Transporting:

1. Delivery tickets shall be required for each batch and shall be in accordance with ASTM C94, Section 16. Each delivery ticket must show plainly the amount of water, in gallons that can be added to the mixer truck at the Site without exceeding the maximum

water cement ratio approved for that mix design. Amount of water added must be in proportion to contents of truck.

2. Arrange and use chutes, troughs, or pipes as aids in placing concrete so that the ingredients of the concrete are not segregated. They shall be steel or steel lined. When steep slopes are necessary, equip the chutes with baffles or make in short lengths that reverse the direction of movement. Extend open troughs and chutes, if necessary, inside the forms or through holes left in the forms. Terminate the ends of these chutes in vertical downspouts.
3. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete by thoroughly flushing with water before and after placement. Discharge water used for flushing away from the concrete in place.
4. Concrete pumping is permitted and shall comply with ACI 304.2R.
5. Carting or wheeling concrete batches on completed concrete floor slab shall not be permitted until the slab has aged at least 4 curing days. Unless pneumatic tired carts are used, wheel the carts on timber planking so that the loads and impact are distributed over the slab. Curing operations shall not be interrupted for the purpose of wheeling concrete over finished slabs.

D. Depositing:

1. The method and manner of placing shall prevent segregation or separation of the aggregate or the displacement of the reinforcement. Use drop chutes of rubber or metal when necessary. Prevent the spattering of forms or reinforcement bars if the spattered concrete dries or hardens before it is incorporated into the mass.
2. Fill each part of the forms by directly depositing concrete as near its final position as possible. Work the coarse aggregate back from the face and force the concrete under and around the reinforcement bars without displacing them. Depositing large quantities at one point in the forms, then running or working it along the forms shall not be permitted.
3. After the concrete has taken initial set, the forms shall not be jarred. No force or load shall be placed upon projecting reinforcement.
4. Deposit the concrete through vertical drop chutes of rubber or metal of satisfactory size when operations involve placing concrete from above, such as directly into an excavated area, or through the completed forms, particularly in walls, piers, columns, and similar structures. Drop chutes shall be made in sections or provided in several lengths so that the outlet may be adjusted to proper heights during placing.
5. Except for drilled shafts, concrete shall not be dropped free more than 10 feet when HRWR admixture is used or 5 feet without HRWR. Place in continuous horizontal layers with a depth of from 1 to 3 feet, depending upon the wall thickness. Each layer shall be soft when a new layer is placed upon it. No more than 1 hour shall elapse between the placing of successive concrete layers in any portion of the structures included in continuous placement.
6. Place required sections in one continuous operation to avoid additional construction joints.
7. If excessive bleeding causes water to form on the surface of the concrete in tall forms, make the mix dryer to reduce the bleeding. In tall walls, place the concrete to a point about 1 foot below the top of the wall and allow to settle for 1 to 2 hours. Resume and complete concreting before set occurs.
8. For slopes greater than two percent, start concrete placement at low end and proceed upslope.

E. Consolidating:
   1. Compact each layer of concrete and flush the mortar to the surface of the forms by continuous-working mechanical vibrators. Vibrators which operate by attachment to forms shall not be used. Apply the vibrator to the concrete immediately after deposit. Move vibrator throughout the layer of the newly placed concrete, several inches into the plastic layer below. Thoroughly work the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms until it is well-compacted.
   2. Mechanical vibrators shall not be operated so that they penetrate or disturb previously placed layers which are partially set or hardened. They shall not be used to aid the flow of concrete laterally. The vibration shall be of sufficient duration to completely compact and embed reinforcement and fixtures, but not to an extent causing segregation.
   3. Keep vibrators constantly moving in the concrete and apply vertically at points uniformly spaced, not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location longer than required to produce a liquefied appearance on the surface.
   4. When submerged in concrete, internal vibrators shall maintain a frequency of not less than 6000 impulses per minute for spuds with diameters greater than 5 inches and 10,000 impulses for smaller spuds. The vibration intensity (amplitude) shall be sufficient to produce satisfactory consolidation.
   5. Provide one vibrator (powered pneumatically or electrically) for each 10 cubic yards of concrete per hour being placed. Provide at least one vibrator, which may be of the gasoline powered type, as a standby for each two vibrators in service. To produce satisfactory consolidation, and based upon the observed performance, the OWNER's representative may require the use of a larger sized and powered vibrator.
   6. Check vibrators intended for regular service or standby service before beginning concreting operations.

F. Placement in Water:
   1. Deposit concrete in water only when dry conditions cannot be obtained. The forms, cofferdams, or caissons shall be sufficiently tight to prevent any water flowing through the space where concrete is to be deposited. Pumping of water shall not be permitted while the concrete is being placed, nor until it has set for at least 36 hours.
   2. Carefully place the concrete compact mass using a tremie, closed bottom dumping bucket, or another approved method which does not permit the concrete to fall through the water without protection. The concrete shall not be disturbed after being deposited. Regulate depositing to maintain horizontal surfaces.
   3. When a tremie is used, it shall consist of a tube constructed in sections having water-tight connections. The means of supporting the tremie shall permit the movement of the discharge end over the entire top surface of the work, and shall allow the tremie to be rapidly lowered to retard the flow. The number of times it is necessary to shift the location of the tremie shall be held to a minimum for any continuous placement of concrete. During the placing of concrete, keep the tremie tube full to the bottom of the hopper. When a batch is dumped into the hopper, slightly raise the tremie, but not out of the concrete at the bottom, until the batch discharges to the level of the bottom of the hopper. Stop the flow by lowering the tremie. Continue placing operations until the work is completed.
   4. When concrete is placed by means of the bottom dump bucket, the bucket shall have a capacity of not less than 1/2 cubic yard. Lower the bucket gradually and carefully

until it rests upon the concrete already placed. Raise it very slowly during the discharge travel to maintain still water at the point of discharge and to avoid agitating the mixture.

5. Use a sump or other approved method to channel displaced fluid and concrete away from the shaft excavation. Recover slurry and dispose of it as approved. Do not discharge displaced fluids into or in close proximity to streams or other bodies of water.

G. Placement in Slabs:

1. Allow concrete in columns, walls and deep beams or girders to stand for at least 1 hour to permit full settlement from consolidation, before concrete is placed for slabs they are to support. Haunches are considered as part of the slab and shall be placed integrally with them.
2. When monolithic slabs are placed in strips, the widths of the strips, unless otherwise specified or indicated, shall insure that concrete in any one strip is not allowed to lie in place for more than 1 hour before the adjacent strips are placed.
3. Immediately before placing concrete, thoroughly dampen the earthen cushion to receive concrete to prevent moisture absorption from the concrete.
4. As soon as concrete placing is complete for a slab section of sufficient width to permit finishing operations, level the concrete, strike off, tamp and screed. The screed shall be of a design adaptable to the use intended, shall have provision for vertical adjustment and shall be sufficiently rigid to hold true to shape during use.
5. The initial strike off shall leave the concrete surface at an elevation slightly above grade so that, when consolidation and finishing operations are completed, the surface of the slab is at grade elevation.
6. Continue tamping and screeding operations until the concrete is properly consolidated and free of surface voids. Bring the surface to a smooth, true alignment using longitudinal screeding, floating, belting, and/or other methods.
7. When used, templates shall be of a design which permits early removal so satisfactory finishing at and adjacent to the template is achieved.
8. While the concrete is still plastic, straightedge the surface using a standard 10-foot metal straightedge. Lap each straightedge pass one-half of the preceding pass. Remove high spots and fill depressions with fresh concrete and re-float. Continue to check with a straightedge during the final finishing operation, until the surface is true to grade and free of depressions, high spots, voids, or rough spots.
9. Check the final surface with a straightedge. Ordinates measured from the face of the straightedge to the surface of the slab shall not exceed 1/16 inch per foot from the nearest point of contact. The maximum ordinate shall be 1/8 inch per 10 feet.
10. Unless noted otherwise, where floor drains are shown in slabs and sloping the slab is not indicated, slope slab to drain on a grade of 1/16 inch per foot with a maximum total slope of 1-1/4 inches. The thickness of slab at floor drain shall be the thickness of slab, as indicated on the Drawings.

H. Placement in Foundations: Place concrete in deep foundations so that segregation of the aggregates or displacement of the reinforcement is avoided. Provide suitable chutes or vertical pipes. When footings can be placed in dry foundation pits without the use of cofferdams or caissons, forms may be omitted and the entire excavation filled with concrete to the elevation of the top of footing. The placing of concrete bases above seal courses is permitted after the forms are free from water and the seal course cleaned. Execute

necessary pumping or bailing during concreting from a suitable sump located outside the forms.

3.7 FINISHING FORMED SURFACES

A. Forms for walls, columns and sides of beams and girders shall be removed as specified in Section 03 11 00 “Concrete Forming.” Patch, repair, finish and clean concrete after form removal. Finish concrete within 7 days of form removal. Cure concrete as finishing progresses.

B. Air voids, for all types of finishes, are defects and shall be removed by rubbing or patching.

C. Finish Schedule:

Type of Finish	Location
No Finish	Surfaces which are not visible from the inside or outside of the completed structure or more than 12” below finish grade (i.e. back of retaining walls below embankment, etc.)
Smooth Finish	Surfaces exposed to view and buried surfaces to a point 12” below grade
Smooth Rubbed Finishes	Exterior surfaces exposed to view, buried surfaces to a point 12” below grade, and interior surfaces for the following structures: • Valve Vaults.

D. No Finish: After forms are removed, repair or patch-tie holes and defects. Otherwise, no additional finish is required.

E. Smooth Finish: Unless otherwise shown on the schedule above, provide smooth form finish for concrete surfaces to be exposed to view. Surfaces to receive a rubbed finish shall have a smooth form finish. The form facing material shall produce a smooth, hard, uniform texture on the concrete. The arrangement of the facing material shall be orderly and symmetrical with a minimum number of seams. Patch tie holes and defects and remove fins flush with the adjacent surface.

F. Smooth Rubbed Finish:
1. Rub surfaces with fluted carborundum stone rubbing at the proper time in the concrete aging process. Rubbing shall remove form marks, surface imperfections, and otherwise smooth, shape, or finish the surface. Proceed with surface rubbings when the forms are removed.
2. After form removal, perform necessary pointing. When the pointing has set sufficiently to permit rubbing, wet surfaces requiring surface finish and rub surface with a No. 16 Carborundum Stone or an abrasive of equal quality. Bring the surface to a paste, to remove all form marks and projections, and to produce a smooth dense surface without pits or irregularities.
3. Carefully spread or uniformly brush the material ground to a paste over the surface and allow to take a reset. The use of cement or plaster to form a surface shall not be permitted.

4. Prepare a 4-by-8-foot panel for the OWNER's approval which shows how final finished surfaces will appear. This panel shall be used as a guide for judging the workmanship of surface finish.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

Finish slabs, platforms and steps monolithically and apply as indicated on the Drawings and the following schedule of finishes:

Type of Finish	Location
Rough Finish	Tank floors that receive grout topping and slabs which receive additional concrete toppings.
Trowel Finish	Slab surfaces exposed to view or to be covered with resilient flooring, carpet, and ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
Broom Finish	Exterior concrete platforms, steps, and ramps.

1. Rough Finish: Provide a rough surface by screeding only without further finish.
2. Trowel Finish:
   a. After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   b. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 1/8-inch.
3. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

B. Give sidewalks a brush finish, unless noted otherwise. Score sidewalks at a spacing equal to the width of the walk and edge on each side using a tool with a radius of approximately ¼-inch.

C. Finishing in Hot, Dry Weather: During periods of high temperature and/or low humidity, take extreme care in finishing the slabs to eliminate initial shrinkage cracks. Following the initial set of concrete, but while the concrete is still "green" continue to finish as required to remove shrinkage cracks which may occur. In hot, dry weather, keep a cement finisher on the job following normal finishing operations for a sufficient length of time to insure the removal of initial shrinkage cracks.

3.9 GROUT FINISHED CHEMICAL TANK FLOORS (NOT USED)

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Concrete Grout:
   1. Prior to grout application, thoroughly clean the surface of all foreign matter and wet down. Thoroughly clean the foundation and the forms set in place and securely

anchor, with holes or cracks in forms caulked with rags, cotton waste or dry sand mixture to prevent the loss of grout. Block grout from entering any sump, drain line, etc. apply grout over the floor surface. The necessary materials and tools shall be on hand before starting grouting operations. Concrete shall be damp when the grout is poured, but shall not have excess water to dilute the grout.

2. After wetting and just prior to grouting, sprinkle the surface lightly with cement to improve the bond between the grout and the surface.
3. After mixing, quickly and continuously place the concrete grout to avoid overworking, segregation and breaking down of the initial set. Mix and place the concrete grout with synthetic reinforcement fibers according to the manufacturer's recommendations. Cure concrete grout using wet curing method for concrete. Concrete grout shall receive a steel trowel finish.

B. Non-Shrink Grout:
1. Obtain field technical assistance from the Grout manufacturer, as required, to insure that grout mixing and installation comply with the manufacturer's recommendations and procedures.
2. Saturate the foundation for non-shrink grouts 24 hours before installation and clear of excess water. Free baseplates or bedplates of oil, grease, laitance and other foreign substances.
3. Place grout according to the manufacturer's directions so that spaces and cavities below the top of the baseplates and bedplates are completely filled. Provide forms where structural components of the baseplates or bedplates do not confine the grout. Where necessary and acceptable under the manufacturer's procedures, a round head pencil vibrator, 3/4-inch maximum diameter may be used to consolidate the grout.
4. Steel trowel finish the non-shrink grout where the edge of the grout is exposed to view and after the grout has reached its initial set. Cut off the exposed edges of the grout at a 45 degree angle to the baseplate, bedplate, member, or piece of equipment.
5. Wet curing should occur for at least 3 days, unless specified by manufacturer, with wet rags, wet burlap or polyethylene sheets. Keep cloths constantly wet for the curing cycle.
6. Clean and dry the foundation, baseplate or other surface of epoxy grouts prior to installation. Dry curing is acceptable for epoxy grouts.
7. Use epoxy non-shrink grout under all machinery, pumps, equipment, and where chemicals are present that would abate cementitious non-shrink grouts.
8. Mix, install, cure, and finish epoxy grouts according to the manufacturer's recommendations. Install grout in recommended lifts to prevent excess heat.

3.11 CONCRETE PROTECTION AND CURING

A. General: Give careful attention to proper concrete curing. The curing methods shall be wet curing, sheet materials conforming to ASTM C171, or membrane curing compound conforming to ASTM C309. Membrane curing is not permitted on surfaces to be rubbed or on surfaces to which additional concrete, plaster mix mortar or terrazzo is to be applied. Unless the curing method is specified otherwise, select the appropriate curing method.

B. Length of Curing Period:
1. A "curing day" shall be any day on which the atmospheric temperature taken in the shade, or the air temperature adjacent to the concrete, remains above 50 F for at least 18 hours.

2. Cure concrete for a period of 7 consecutive days. In cold weather, when curing may be retarded, extend this period to 7 "curing days", up to a limit of 14 consecutive days.

C. Wet Curing:
   1. Immediately following the finishing operations, cover concrete slabs, including roof slabs, with wet cotton mats or with a temporary covering of canvas or burlap. Keep thoroughly wet for a period of 4 curing days after the concrete is placed. The covering shall be held in direct contact with the concrete. A temporary covering shall be required when the size of slab, size of mats, or other factors dictate that the mats cannot be placed immediately after the finishing operations without marring the finishing of the slab.
   2. Water used for curing shall be free from injurious amounts of oil, acid, alkali, salt, or other deleterious substances.
   3. Canvas or burlap covering material shall weigh not less than 12 ounces per square yard. Place the sections with a lap at the edges of at least 8 inches. Saturate cover material with water previous to placing. Keep saturated as long as it remains in place. Use care in the placing of the cover material to prevent marring the concrete surface.
   4. When temporary coverings are used, keep them in place only until the slab has sufficiently hardened so that a cotton mat covering can be substituted without marring or disturbing the slab finish. Thoroughly saturate cotton mats before placing and keep the mats on the slab in a saturated condition for a period of at least 4 curing days.

D. Sheet Curing: Sheet materials shall conform to ASTM C171. They shall be in contact with the entire concrete surface and applied according to the manufacturer's recommendations. Patch all holes. Where pedestrian traffic is unavoidable, provide suitable walkways to protect the sheet material.

E. Membrane Curing:
   1. Membrane curing shall not be used on surfaces which receive paint, floor hardener, or plaster mix finish or other finish which would be hindered by the use of the curing compound.
   2. Cover the surface of the concrete with a continuous, uniform, water-impermeable coating, conforming to ASTM C309 "Liquid Membrane Forming Compounds for Curing Concrete" and apply according to ACI 308.
   3. Immediately after the removal of the side and end forms, apply a coating to the sides and ends of all concrete. Apply the solution under pressure with a spray nozzle so that the entire exposed surface is completely covered with a uniform film. The rate of application shall insure complete coverage, but the area covered shall not exceed 150 square feet per gallon of curing compound.
   4. The coating shall be sufficiently transparent and free of permanent color to not result in a pronounced color change from that of the natural concrete at the conclusion of the curing period. The coating shall, however, contain a dye of color strength to render the film distinctively visible on the concrete for a period of at least 4 hours after application.
   5. After application and under normal conditions, the curing compound shall be dry to touch within 1 hour and shall dry thoroughly and completely within 4 hours. When thoroughly dry, it shall provide a continuous flexible membrane free from cracks or pinholes and shall not disintegrate, check, peel, or crack during the required curing period.

6. If the seal is broken during the curing period, immediately repair it with additional sealing solution.

3.12 CONCRETE SURFACE REPAIRS

A. After the tie rods are broken back or removed, thoroughly clean the holes to remove grease and loose particles. Patch holes with structural concrete repair material. After the holes are completely filled, strike off flush excess mortar and finish the surface to render the filled hole inconspicuous.

B. If the surface of the concrete is bulged, uneven, or shows honeycombing or form marks, which in the ENGINEER's opinion cannot be repaired satisfactorily, remove and replace the entire section.

C. Patch honeycomb and minor defects in all concrete surfaces with structural concrete repair material. Cut back each defective area with a pneumatic chipping tool as deep as the defect extends, but in no case less than 1/2 inch. Prepare the existing concrete according to the recommendations of patching material manufacturer's. Apply repair material according to the manufacturer's recommendations. Finish the surface of the patches to match finish on surrounding concrete.

3.13 FIELD QUALITY CONTROL

A. Testing:
   1. General:
      a. Tests shall be required throughout the Work to monitor the quality of concrete. Samples shall be taken in accordance with ASTM C172.
      b. The ENGINEER may waive these requirements on concrete placements of ten cubic yards or less. However, evidence shall be furnished showing a design mix which meets the Specifications.
      c. Unless noted otherwise, testing of the materials, ready mix, transit mix or central plant concrete will be by an independent testing agency. The OWNER will select and pay for this service. A summary of all tests performed will be available. No concrete shall be placed without a representative present at either the plant or at the Site.
      d. Unless the OWNER's laboratory is on the Site, provide housing for the curing and storage of test specimens and equipment.
   2. Slump Test: Slump tests, in accordance with ASTM C143, shall be used to indicate the workability and consistency of the concrete mix from batch to batch. Generally, a slump test shall be made at the start of operations each day, at regular intervals throughout a working day, and at any time when the appearance of the concrete suggests a change in uniformity.
   3. Air Content Test: Tests for the concrete's air content shall be made in accordance with ASTM C231 or ASTM C173, at the point of delivery of concrete, prior to placing in forms. The test shall be made frequently to monitor a proper air content uniform from batch to batch.
   4. Temperature Test: The temperature of the concrete to be placed shall be taken with a thermometer immediately before placement, with the point of measurement being in the chute or bucket. Temperature test shall be performed for each truck. Record temperatures on batch ticket.
   5. Compression Test:

a. Compression test specimens shall be 6-by-12-inch concrete cylinders made and cured in accordance with ASTM C31. If the maximum aggregate size is no longer than 1 inch, 4-by-8-inch concrete cylinders are acceptable. No fewer than two 6-by-12-inch or three 4-by-8-inch specimens shall be made for each test Sample. Samples shall be taken at a minimum of every 50 cubic yards of concrete for each class placed. At least one set of test specimens per day shall be made for each class of concrete used that day. Specimens shall be cured under laboratory conditions specified in ASTM C31. Additional concrete cylinders may be required for curing on the job under actual job curing conditions. These Samples could be required when:
   1) There is a possibility of the air temperature surrounding the concrete falling below 40 F, or rising above 90 F.
   2) The curing procedure may need to be improved and/or lengthened.
   3) It is necessary to determine when the structure may be put into service.

b. Compression strength tests shall be made on the laboratory-cured and job-cured concrete cylinders at 7 and 28 days, in accordance with ASTM C39. The value of each test result shall be the average compressive strength of all of the cylinders in the test Sample. Two additional concrete cylinder shall be held or tested at 56-days, if necessary. All cylinders within a test Sample shall be taken at the same time from the same batch of concrete. For the 28-day cylinders, the strength level shall be considered satisfactory based on the requirements of ACI 301.

6. Failure to Meet Requirements:

a. Should the 7-day strengths shown by the test specimens fall below the required values, additional curing shall be performed on those portions of the structures represented by the test specimens at the Contractor's expense. Test cores shall be obtained and tested in accordance with ASTM Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, Designation C 42. If additional curing does not give the strength required, the OWNER reserves the right to require strengthening, replacement of those substandard portions of the structure, or additional testing, at the Contractor's expense.

b. Upon receipt of the Contractor's written request, substandard concrete work may be reexamined in place by nondestructive testing methods or core Samples, in accordance with ACI 301. The services of an independent testing laboratory shall be retained and all expenses paid without compensation from the OWNER. Laboratory results shall be evaluated by the ENGINEER, who shall make the final decision on acceptability of the concrete in question. Core Sample holes shall be repaired with non-shrink, epoxy structural grout.

B. The OWNER may withhold payment for any section of concrete which does not meet the requirements of the Specifications. Withheld payment shall be based upon the unit prices established for concrete and reinforcing steel. Payment shall be withheld until the unacceptable concrete has been refinished, removed and replaced or otherwise brought into conformance with the Specifications.

C. PVC Waterstops: Waterstops shall be observed by the OWNER's representative prior to concrete placement. Unacceptable splicing defects include:
1. Misalignment of center bulb, ribs and end bulbs greater than 1/16 inch.
2. Bond failure at joint deeper than 1/16 inch.
3. Misalignment which reduces waterstop cross-section more than 15 percent.

4. Bubble or visible porosity in the weld.
5. Visible signs of splice separation when a cooled splice is bent by hand at a sharp angle.
6. Charred or burnt material.

END OF SECTION

Concrete Mix Design

Project Name: _____

Plummer Project Number: _____

Project Location: _____

Owner: _____

General Contractor: _____

Mix Number / Class: _____

A. Mix Design:

Cement	=	_____	lb/yd³
Fly Ash	=	_____	lb/yd³
Other Cementitious Material: _____	=	_____	lb/yd³
Fine Aggregate	=	_____	lb/yd³
Course Aggregate	=	_____	lb/yd³
Water	=	_____	lb/yd³
Water Reducing Admixture	=	_____	oz/yd³
High Range Water Reducer	=	_____	oz/yd³
Air Entraining Admixture	=	_____	oz/yd³
Other Admixture: _____	=	_____	oz/yd³
Slump	=	_____	inches
Gross Weight	=	_____	lb/yd³
Air Content	=	_____	percent
Water/Cement Ratio	=	_____	

B. Materials:

	Source	ASTM	Type	Remarks
Cement				
Fly Ash				
Other Cementitious Material: _____				
Fine Aggregate				
Coarse Aggregate				
Water				
Water Reducer				
High Range Water Reducer				
Air Entraining				
Other Admixture: _____				

C. Determination of Average Strength Required (fcr'):
   1. Test Records Available:
      a. Summary of Test Records (Provide Supporting Documentation):

Test Group No.	No. of Consecutive Tests	Specified Strength (psi)	Standard Deviation (psi)
		Average Standard Deviation:	

      b. Standard Deviation Modification Factor (ACI 30 1, Table 4.2.3.3.a): ___.
      c. Standard Deviation Used: ___.
      d. Average Compressive Strength Required: ___.
   2. Test Records Not Available:
      a. Average Compressive Strength Required (ACI 30 1, Table 4.2.3.3.b, if required): ___.

D. Documentation of Required Average Compressive Strength (Check One):
   1. Field Strength:
      a. Field Strength Test Records (ACI 30 1, Table 4.2.3.3.a): ___.
         1) *Complete Attachment A.
   2. Trial Mixtures:
      a. Trial Mixtures (ACI 301, Table 4.2.3.3.b, if required): ___.
         2) *Complete Attachment B.

I, _____ certify that the above information is correct and all gradations, cement certifications and test results are located at our place of business for review by the ENGINEER.

Name: _____ Date: _____

Title: _____

Company: _____

_____

_____

Attachment A

Documentation of Required Average Strength – Field Strength Records

(ACI 301, 4.2.3.4.a)

A. Summary of Test Records (Provide Supporting Documentation):

Test Record No.	No. of Tests in Record	Duration of Record (days)	Water-Cementitious Materials Ratio	Average Strength (psi)

B. Interpolation used? _____.
   1. Provide an interpolation calculation or plot of strength versus proportions.

C. Submit the following data for each mix:
   1. Brand, type and amount of cement.
   2. Brand, type and amount of each admixture.
   3. Source of each material used.
   4. Amount of water.
   5. Proportions of each aggregate material per cubic yard.
   6. Gross weight per cubic yard.
   7. Measured slump.
   8. Measured air content.
   9. Results of consecutive strength tests.

Attachment B

Documentation of Required Average Strength – Trial Mixtures

(ACI 301, 4.2.3.4.b)

A. Summary Of Test Record(s):

Trial Mix No.	7-Day Tests		28-Day Tests		Water-Cementitious Materials Ratio	Slump (in)	Air Content (%)	Temperature (F)
	No. of Test Cylinders	Strength (psi)	No. of Test Cylinders	Strength (psi)				

B. Maximum water-cementitious materials ratio _____.
   1. Provide an interpolation calculation or plot of strength versus water-cementitious materials ratio.

C. Submit the following data for each mix:
   1. Brand, type and amount of cement.
   2. Brand, type and amount of each admixture.
   3. Amount of water used in trial mixes.
   4. Proportions of each aggregate material per cubic yard.
   5. Gross weight per cubic yard.
   6. Measured slump.
   7. Measured air content.
   8. Compressive strength developed at 7 days and 28 days, from not less than three test cylinders cast for each 7-day and 28-day test.

END OF ATTACHMENTS

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Steel framing and supports for mechanical and electrical equipment.
   2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   3. Metal Bollards.
   4. Metal Ladders and Safety Cages.
   5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:
   1. Embedment including embedded anchors and anchor bolts, steel pipe sleeves, and slotted-channel inserts indicated to be cast into concrete.
   2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:
   1. Section 03 30 00 “Cast-In-Place Concrete” for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, and other items cast into concrete.
   2. Section 05 53 00 “Metal Gratings”

1.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120° F, ambient; 180° F, material surfaces.

B. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   2. Provide templates for anchors and bolts specified for installation under other Sections.

B. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code - Steel."
   2. AWS D1.2, "Structural Welding Code - Aluminum."
   3. AWS D1.3, "Structural Welding Code - Sheet Steel."
   4. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36.

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A240 or ASTM A666, Type 316L.

C. Stainless-Steel Bars and Shapes: ASTM A276, Type 316L.

D. Steel Tubing: ASTM A500, cold-formed steel tubing.

E. Steel Pipe: ASTM A53, standard weight (Schedule 40) unless otherwise indicated.

F. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.
2. Material: Galvanized steel, ASTM A653, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.
3. Material: Cold-rolled steel, ASTM A1008, structural steel, Grade 33; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.

G. Cast Iron: Either gray iron, ASTM A48, or malleable iron, ASTM A47, unless otherwise indicated.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

C. Aluminum Castings: ASTM B26, Alloy 443.0-F.

D. Bronze Plate, Sheet, Strip, and Bars: ASTM B36, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

E. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

F. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semi-red brass).

G. Nickel Silver Extrusions: ASTM B151, Alloy UNS No. C74500.

H. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners. Select fasteners for type, grade, and class required.
1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 2.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
1. Material: Alloy Group 2 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

C. Shop Primers: Provide primers that comply with Section 09 90 00 “Painting and Protective Coatings.”

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with primer specified in Section 09 90 00 “Painting and Protective Coatings” where indicated.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Prime bollards with primer specified in Section 09 90 00 “Painting and Protective Coatings.”

2.9 METAL LADDERS AND SAFETY CAGES

A. General:
1. Comply with ANSI A14.3, unless otherwise indicated.
2. Space siderails 16 inches apart, unless otherwise indicated.

B. Type 316 Stainless Steel Ladder Construction:
1. Flat bar siderails, with 3/4-inch- diameter Type 316 stainless steel bar rungs fitted in centerline of siderails, plug-welded, and ground smooth on outer rail faces.
2. Provide rungs with ribbed tread surfaces.

C. Aluminum Ladder Construction:
1. Extruded channel or tube siderails, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick; with extruded tube rungs, not less than 3/4 inch deep and not less than 1/8 inch thick, fitted into centerline of siderails and fastened by welding or with stainless-steel fasteners or brackets and aluminum rivets.
2. Provide rungs with ribbed tread surfaces.

D. Internal Ladders from Roof or Ceiling Hatches: For ladders greater than eight feet, provide stainless steel or aluminum ladder extension, consisting of a single pole extension 42-inches above top ladder rung, rotating locking mechanism, and two ladder rung clamps.

E. Fall Prevention Device: When required by OSHA, each ladder shall have a fall prevention device attached. This device shall consist of a sliding locking mechanism and safety belt. This device shall fully comply with OSHA standards.

F. Safety Cages:
1. Fabricate ladder safety cages to comply with ANSI A14.3.
2. Fabricate from same metal as ladders to which safety cages are attached and assemble by welding or riveting.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates. Prime plates with primer specified in Section 09 90 00 “Painting and Protective Coatings.”

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153 for steel and iron hardware and with ASTM A123 for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete or masonry, or unless otherwise indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   3. Items Indicated to Receive Primers Specified in Section 09 90 00 "Painting and Protective Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.14 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Dull Satin Finish: No. 6.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.15 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING METAL BOLLARDS

A. Anchor bollards in place with concrete footings. Center and align bollards in holes three inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use non-shrink, non-metallic grout.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 “Painting and Protective Coatings.”

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

SECTION 05 50 10
ANCHOR BOLTS, EXPANSION ANCHORS, AND CONCRETE INSERTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Provide anchor bolts, expansion anchors and concrete inserts for equipment and metal fabrications as specified or shown on the Drawings, including, but not limited to:
      a. Baffles, weirs, and troughs.
      b. Sprockets and conveyors.
      c. Rails.
      d. Sluice and slide gates.
      e. Hangers and brackets.
      f. Equipment.
      g. Piping.
      h. Tanks.
      i. Grating and floor plate.
      j. Electrical, Plumbing and HVAC Work.
      k. Wood and plastic fabrications.
      l. Partitions and ceilings.

B. Related Sections:
   1. Section 40 05 01 “Basic Piping Systems, Basic Materials and Methods,” for pipe joining materials.
   2. Section 40 05 07 “Hangers and Supports for Process Piping” for requirements for hangers and supports for equipment and piping systems, as an engineered system by the Contractor.

1.3 REFERENCES AND DEFINITIONS

A. References:
   1. American Concrete Institute (ACI):
      a. ACI 318, Appendix D - Building Code Requirements for Structural Concrete and Commentary; Anchoring to Concrete.
      b. ACI 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary
   2. ASTM International (ASTM):
      a. A 36 – Specification for Carbon Structural Steel
      b. A 193 – Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
      c. A 194 – Specification for Carbon and Alloy Steel for Bolts for High Pressure or High Temperature, or Both

d. A 283 – Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
e. A 307 – Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners
f. A 320 – Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service
g. C 881 – Specification for Epoxy-Resin-Base Bonding Systems for concrete
h. E 488 – Test Method for Strength of Anchors in Concrete and Masonry Units
i. E 1512 – Test Method for Testing bond Performance of Bonded Anchors
j. F 436 – Specification for Hardened Steel Washers
k. F 593 – Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
l. F 594 – Specification for Stainless Steel Nuts
m. F 844 - Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
n. F 1554 – Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

3. International Building Code, 2006 or later edition.
4. ICC Evaluation Service, Inc. (ICC ES):
   a. AC193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
   b. ESR - Evaluation Service Report
5. FM Global (Formerly: FM - Factory Mutual System)
6. National Sanitation Foundation International (NSF)

B. Definitions:
1. Exterior Area: Location not protected from the weather by a building or other enclosed structure.
2. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, not where wall or roof slab is common to a water-holding or earth-retaining structure.
3. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
4. Submerged: Location at or below top of wall or embankment of open water-holding structure, such as a basin or channel, or wall, a ceiling, or floor surface inside a covered water-holding structure, or an exterior below grade wall or roof surface of a water-holding structure (open or covered).

1.4 SYSTEM DESCRIPTION

A. Design Requirements:
1. Designed in accordance with ACI 318 (Strength Design method using Appendix D) for use in cracked and uncracked concrete.
2. Testing Requirements: Tested in accordance with ACI 355.2 and ICC ES AC193 for use in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors).
3. When the size, length, or load-carrying capacity of an anchor bolt, expansion anchor, or concrete insert is not shown on the Drawings, provide the size, length and capacity required to carry the design load in accordance with ACI 318, Appendix D for cracked and uncracked concrete.
4. Determine design loads as follows:

a. For equipment anchors, use the design load recommended by the manufacturer and approved by the ENGINEER.
b. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories, and water contained in pipe between the hanger or support in question, and adjacent hangers and supports on both sides.

1.5 SUBMITTALS

A. Product Data:
1. For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for products.
2. Provide the ICC ES Evaluation Service Report (ESR Number) for each fastener.

B. Shop Drawings: Submit the following:
1. Setting drawings and templates for location and installation of anchorage devices.
2. Copies of manufacturer's specifications, materials, load tables, dimension diagrams, and installation instructions for anchorage devices.

C. Samples: Submit representative samples of bolts, anchors, and inserts as may be requested for review by the ENGINEER. Review will be for type and finish only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

1.6 QUALITY ASSURANCE

A. Manufacturer:
1. Manufacturer shall have been engaged in the manufacturer of anchor bolts, expansion anchors, concrete inserts, and related items for a minimum of ten (10) years.
2. ISO 9001 Certified.

B. Installer Qualifications: Adhesive anchor installers shall be trained and certified by manufacturer.

C. Testing Agency Qualifications: Qualified for testing anchors in accordance with ASTM E 488 and E 1512 and has performed ICC ES method of evaluation.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, comply with the following requirements:

Table 1
Material Requirements

Item	ASTM Reference
Stainless Steel:	
Bolts, Threaded Rods, and Anchor Studs	F 593, AISI Type 316, Condition CW
Nuts	F 594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A 307 bolts, with A 563 nuts
High-Strength	A 325, Type 1 bolts, with A 563 nuts

Table 1 Material Requirements	
Item	**ASTM Reference**
Anchors Bolts and Rods	F 1554, Grade 55, with weldability supplement S1
Eyebolts	A 489
Threaded Rods	A 36
Flat Washers (Unhardened)	F 844
Flat and Beveled Washers (Hardened)	F 436
Thrust Ties for Steel Pipe:	
Threaded Rods	A 193, Grade B7
Nuts	A 194, Grade 2H
Plate	A 283, Grade D

B. Bolt, Washers, and Nuts: Use stainless steel and carbon steel types, as indicated in Fastener Schedule at end of this Section.

2.2 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:
   1. Headed type, unless otherwise shown on Drawings.
   2. Material type and protective coating as listed in Fastener Schedule.

B. Anchor Bolt Sleeves:
   1. Plastic:
      a. Single unit construction with corrugated sleeve.
      b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
      c. Material: High density polyethylene.
   2. Fabricated Steel: ASTM A 36.

2.3 CONCRETE AND MASONRY DRILLED ANCHORS

A. Mechanical Expansion Anchors:
   1. Design Requirements: Anchor bolt and sleeve assembly shall have capability to sustain without failure, as determined by the Strength Design method when installed in cracked and uncracked concrete, in accordance with the International Building Code and as determined by testing in accordance with ASTM E 488 and AC-355.2.
   2. Material: AISI Type 304, AISI Type 316 stainless steel, and carbon steel as listed in Fastener Schedule.
   3. Current evaluation and acceptance reports by ICC or other similar code organization, and listed by UL and FM Global.
   4. Acceptable for use in potable water structures by NSF and local health organizations.
   5. Type:
      a. ICC-ES Code Listed, Category 1, Cracked and Uncracked Concrete.
      b. Self-drilling Anchors; snap-off or flush type, zinc-plated.
      c. Non-drilling Anchors; flush type for use with zinc-plated or stainless steel bolt, or stud type with projecting threaded stud.
   6. Size: As shown on Drawings and required for the concrete strength specified.

7. Manufacturers. Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
    a. ITW Ramset/Red Head, Wood Dale, IL.
    b. Hilti, Inc., Tulsa, OK
    c. Powers Fasteners, New Rochelle, NY
    d. Simpson Strong-Tie Co., Inc., Pleasanton, CA

B. Wedge Bolts:
1. Material: Zinc-plated, case-hardened carbon steel.
2. Current evaluation and acceptance reports by ICC or other similar code organization, and listed by UL and FM Global.
3. Type:
    a. ICC-ES Code Listed, Category 1, Cracked and Uncracked Concrete.
    b. Description: One piece, heavy duty screw anchor with finished hex head suitable for cracked and uncracked concrete and grouted masonry.
4. Size: As shown on Drawings and required for the concrete strength specified.
5. Manufacturers. Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
    a. ITW Ramset/Red Head, Wood Dale, IL.
    b. Hilti, Inc., Tulsa, OK
    c. Powers Fasteners, New Rochelle, NY
    d. Simpson Strong-Tie Co., Inc., Pleasanton, CA

C. Internally Threaded Drop-In (Snake) Anchors:
1. Material: Zinc plated, case hardened carbon steel.
2. Current evaluation and acceptance reports by ICC or other similar code organization, and listed by UL and FM Global.
3. Type:
    a. ICC-ES Code Listed, Category 1, Cracked and Uncracked Concrete.
    b. Description: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete and grouted masonry. Suitable base materials included normal-weight concrete, structural lightweight concrete, and concrete over metal deck.
4. Size: As shown on Drawings and required for the concrete strength specified.
5. Manufacturers. Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
    a. ITW Ramset/Red Head, Wood Dale, IL.
    b. Hilti, Inc., Tulsa, OK
    c. Powers Fasteners, New Rochelle, NY
    d. Simpson Strong-Tie Co., Inc., Pleasanton, CA

D. Adhesive Anchors:
1. General: Adhesive anchoring system designed for bonding threaded anchor rod and reinforcing bar hardware into drilled holes in concrete and solid masonry base materials.
2. Threaded rod:
    a. Material: Unless otherwise specified:
        1) ASTM A36 for interior application, unless otherwise specified.
        2) ASTM F 593 Stainless steel threaded rod for exterior, interior wet, and submerge applications.

3) ASTM A 193, Grade B7, Type 2 for high strength applications.

b. Diameter as shown on the Drawings or as required for the loads and conditions.

c. Length as required to provide minimum depth of embedment.

d. Clean and free of grease, oil, or other deleterious material.

e. For hollow-unit masonry, provide galvanized or stainless steel wire cloth screen tube to fit threaded rod.

f. Anchor rods shall have rolled threads.

3. Adhesive:

a. Two-component, high strength adhesive anchoring system designed to be used in adverse/thaw environments, with gray color mixing.

1) ICC-ES Code Listed.

2) Cure Temperature, Pot Life, and Workability: Compatible for the intended use and environmental conditions.

3) Non-sag, with selected viscosity base on installation temperature and overhead application where applicable.

4) ASTM Compliance:

a) Uncracked Concrete: Meets ASTM C881, Types I, II, IV, and V, Grade 3, Class A and B.

b) Uncracked and Cracked Concrete: Meets ASTM C881, Types I, II, IV, and V, Grade 3, Class B and C.

5) Compliant with NSF/ANSI Standard 61 for potable water applications.

6) Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

a) ITW Ramset/Red Head, Wood Dale, IL.

b) Hilti, Inc., Tulsa, OK

c) Powers Fasteners, New Rochelle, NY

d) Simpson Strong-Tie Co., Inc., Pleasanton, CA

E. Concrete Inserts:

1. For piping, grating and floor plate provide malleable iron inserts.

2. Provide those recommended by the manufacturer for the required loading.

3. Finish shall be black.

F. Powder-actuated fasteners and other types of bolts and fasteners not specified herein shall not be used, unless approved by ENGINEER.

PART 3 - EXECUTION

3.1 CAST-IN-PLACE ANCHOR BOLTS

A. Accurately locate and hold anchor bolts in place with templates at the time concrete is placed.

B. Use anchor bolt sleeves for location adjustment, and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.2 CONCRETE AND MASONRY DRILLED ANCHORS

A. Begin installation only after concrete or masonry to receive anchors has obtained design strength.

B. Install in accordance with manufacturer's instructions.

C. Provide minimum embedment, edge distance, and spacing as follows, unless indicated otherwise by manufacturer's instructions or shown otherwise on Drawings.

Table 2
Minimum Requirements
Concrete and Masonry Drilled Anchors

Anchor Type	Min. Embedment (bolt diameters)	Min. Edge Distance (bolt diameters)	Min. Spacing (bolt diameters)
Wedge	9	6	12
Expansion and Sleeve	4	6	12
Adhesive	9	9	13.5

D. Use only drill type, bit type, and diameter recommended by anchor manufacturer. Clean hole of debris and dust with brush and oil-free compressed air.

E. Contractor shall accurately locate steel reinforcement by the use of a pachometer or other approved means, prior to drilling the hole. If reinforcing is encountered in drilling holes for mechanical anchors, the hole should be abandoned and a new hole should be drilled.

F. Mechanical anchors shall be set by applying the manufacturer's recommended torque.

G. Adhesive Anchors:
   1. Do not install adhesive anchors when temperature is below 40 degree F or above 100 degree F.
   2. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
   3. For hollow-unit masonry, install screen tube in accordance with manufacturer's instructions.
   4. Do not disturb anchor during recommended curing time.
   5. Do not exceed maximum torque specified in manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: OWNER will engage a qualified testing agency to perform tests and inspections on concrete and masonry anchors when indicated on the Drawings.

3.4 MANUFACTURER'S SERVICES

A. Adhesive Anchors: Conduct site training of installation personnel for proper installation, handling, and storage of adhesive anchor system.

3.5 FASTENER SCHEDULE

A. Unless otherwise indicated on the Drawings, provide anchor bolts and anchors as shown in Table 3.

B. Anti-seizing Lubricant: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degree F.

Table 3: Fastener Schedule Requirements for Anchor Bolts and Anchors		
Service Use and Location	**Product**	**Remarks**
1. Anchor Bolts Cast into Concrete for Equipment Bases		
Interior Dry Areas	Stainless steel headed anchor bolts, unless otherwise specified with equipment.	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment.	See Section 09 90 00, "Painting and Protective Coatings."
2. Drilled Anchors for Equipment and Components to Cast-in-Place Concrete		
Interior Dry Areas	Adhesive zinc-plated carbon steel anchors.	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Adhesive stainless steel anchors.	
3. Anchors in Grout-Filled Concrete Masonry Units		
Exterior and Interior Wet and Dry Areas	Zinc-coated carbon steel or stainless steel adhesive anchors.	
4. Anchors in Hollow Concrete Masonry Units		
Exterior and Interior Wet and Dry Areas	Zinc-plated carbon steel or stainless steel wedge anchors or stainless steel adhesive anchors with screen tube.	
5. Connections for Structural Steel Framing and Support Components		
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections.	Use hot-dipped galvanized, high-strength bolted connections for galvanized steel framing members.
6. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	Stainless steel bolted connections, unless otherwise specified with equipment.	
7. Overhead Pipe and Duct Supports		
Exterior and Interior Wet and Dry Areas	Snake anchors or adhesive anchoring systems.	

END OF SECTION

SECTION 09 90 00
PAINTING AND PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the surface preparation and application of high-performance coating systems on the following substrates:
   1. Exterior substrates:
      a. Concrete, vertical and horizontal surfaces.
      b. Clay masonry.
      c. Concrete masonry units (CMU).
      d. Steel.
      e. Galvanized metal.
      f. Aluminum (not anodized or otherwise coated).
      g. Wood.
      h. Plastic trim fabrications.
      i. Exterior Portland cement (stucco).
      j. PVC pipe and fiberglass tanks.
   2. Interior Surfaces:
      a. Concrete.
      b. Clay masonry.
      c. Concrete masonry units (CMU).
      d. Steel.
      e. Galvanized metal.
      f. Aluminum (not anodized or otherwise coated).
      g. Wood.

B. Related Sections:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
   2. Applicable equipment Sections for manufacturer's special coatings of equipment.

1.2 REFERENCES AND DEFINITIONS

A. References:
   1. ASTM International (ASTM)
      a. D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
      b. D2016 - Test Method for Moisture Content of Wood.
   2. The Society for Protective Coatings (SSPC)
      a. SSPC Painting Manual, "Good Painting Practice."
      b. SSPC Painting Manual, "Systems and Specifications."
      c. SSPC-SP1 Solvent Cleaning.

d. SSPC-SP3 Power Tool Cleaning.
e. SSPC-SP5 White Metal Blasting.
f. SSPC-SP6 Commercial Blast Cleaning.
g. SSPC-SP7 Brush-Off Blast Cleaning.
h. SSPC-SP10 Near-White Blast Cleaning.
i. SSPC-SP12 Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating.
j. SSPC-SP13 Surface Preparation of Concrete.
k. SSPC-SP14 Industrial Blast Cleaning.
l. SSPC-SP16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
m. SSPC-VIS 1 89 Visual Standard for Abrasive Blast Cleaned Steel.

3. NACE International (National Association of Corrosion Engineers International)
   a. RP0287-95 “Field Measurements of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape.”
   b. RP0188-99 “Discontinuity (Holiday) Testing of Protective Coatings.”
   c. TM-01-70 “Visual Comparator for Surfaces of New Steel Airblast Cleaned with Sand Abrasive.”
   d. RP0178-95 “Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service.”
   e. RPO 892-92 “Linings Over Concrete for Immersion Service.”
   f. RPO 591-96 “Coatings for Concrete Surfaces in Non-Immersion.”
   g. 6G186 “Surface Preparation of Contaminated Steel Surfaces.”
   h. 6G191 “Surface Preparation of Contaminated Concrete.”
   i. RPO 178 “Weld preparation Visual Comparator.”
4. National Association of Pipe Fabricators (NAPF)
   a. 500-03-01 “Solvent Cleaning.”
   b. 500-03-04 “Abrasive Blast Cleaning for Ductile Iron Pipe.”
   c. 500-03-05 “Abrasive Blast Cleaning for Cast Ductile Iron Fittings.”
5. National Science Foundation (NSF)

B. Definitions:
   1. Conform to ASTM D16 for interpretation of terms used in this Section.
   2. Exposed Surfaces: Used to define painting locations and requirements, it shall include visible interior or exterior surfaces, top of walls, ceilings, and inside surfaces to 1'-0" below grade or the weir level or to floor level, whichever applies.

1.3 SUBMITTALS

A. Product Data: Submit product data, certificates, and application instructions for each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:
   1. Show where each coating is to be used on the Project, with cross reference to this Section paragraphs and Painting Schedule.
   2. Product date and information submitted shall demonstrate compliance with this Section.
   3. Provide the surface preparation required or recommended by coating manufacturer for each type of coating application if different from that specified in this Section.

E. Provide ENGINEER with certification from coating supplier that sufficient paint has been purchased to provide required quantity of coatings for Project.
   1. Certificate shall list the quantities and types of paint purchased.

F. Provide ENGINEER with certification from the blast cleaning supplier that sufficient materials have been purchased to provide for the surface preparation specified for Project.
   1. Certificate shall list the quantities and gradation purchased.

G. Manufacturer's Instructions:
   1. Provide manufacturer's instructions for the application of the coating system for the purpose intended by these specifications. The instructions shall provide the limitations, precautions, and requirements that may adversely affect the coating system; that may cause unsatisfactorily results after the application; or that may prevent the coating system not to serve the purpose for which it was intended, which is to provide coverage and protection from corrosion, and shall be clearly stated.
   2. The instructions shall include, but not limited to:
      a. Surface preparation.
      b. Methods of Application.
      c. Number of coats.
      d. Thickness of each coat.
      e. Total Thickness.
      f. Drying time of each coat, including primer.
      g. Drying time of final coat before placement in service.
      h. Time allowed between coats.
      i. Primers required to be used.
      j. Primers not permitted.
      k. Use of a primer.
      l. Compatible topcoats.
      m. Thinner and use of thinner.
      n. Weather limitations during and after application (temperature, humidity, wind velocity).
      o. Protection from sun.

p. Physical properties of paint, including percent solids content by volume, ingredient analysis, and weight per unit surface per dry mil thickness.

q. Cathodic disbonding limitations.

r. Equipment settings (air cap, fluid tip, equipment pressure settings, etc.)

H. Field Quality-control Reports: Provide temperature and humidity readings, testing for coating dry mil thickness and bonding, surface preparation, and related coating testing.

I. Pre-installation Conference: Provide minutes of the pre-installation conference.

1.4 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality coating products with 10 years' experience.

B. APPLICATOR: Company specializing in industrial painting and finishing with five (5) years documented experience, approved by product manufacturer.

C. CONTRACTOR shall apply coatings systems from only one manufacturer for each type of application.

D. CONTRACTOR shall coordinate materials to be painted, shop primers, field primers, and finish coating systems to ensure compatibility for materials and coatings in this project.

E. All coatings in contact with potable water and water being treated for use as potable water shall conform to ANSI/NSF Standard 61 and ANSI/NSF Standard 600 and shall be certified by an organization accredited by ANSI. Process, service water, potable, and chemical piping, fittings, tanks, valves, equipment, and structures in contact with the water being treated are included in this requirement.

F. Coating system manufacturer shall review actual job conditions prior to purchase of any materials. Manufacturer shall submit to ENGINEER a statement listing any exceptions to the specifications regarding preparation requirements or coating applicability.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

B. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect products in accordance with manufacturer's instructions.

B. Deliver products to site in the original, sealed, labeled, and unopened containers; inspect to verify acceptance. Damaged containers will not be accepted.

C. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

D. Store paint materials in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F (7 degrees C) and not more than 90 degrees F (32 degrees C).

E. Take precautionary measures to prevent fire hazards and spontaneous combustion. Remove oily rags, waste, or other fire hazards from facilities each night. Place cloths and cotton waste, which might constitute a fire hazard, in metal containers or destroy at the end of

each workday.

1.7 PROJECT CONDITIONS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F (7 degrees C) for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 degrees F (10 and 35 degrees C).

C. Do not apply coatings in:

1. snow, rain, mist or fog;
2. or when relative humidity meets or exceeds 85 percent;
3. or at temperatures less than 5 degrees F (3 degrees C) above the dew point;
4. or when the air temperature is predicted to drop below 45 degrees F (7 degrees C) or less than 5 degrees F (3 degrees C) above the dew point within 8 hours of applying coating unless surface is enclosed and heated;
5. or to damp or wet surfaces.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish and Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Comply with manufacturer’s instructions for coating application and environmental conditions, which may be more stringent than the minimum requirements listed in this specification.

G. Provide lighting level of 80-foot-candles measured mid-height at substrate surface.

H. CONTRACTOR shall be fully responsible for personnel safety during painting operations.

1. Display caution signs in necessary areas advising of spray painting and warning against open flames.
2. Provide barriers or shelters on windy days to protect equipment and facilities.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish an additional 5 percent, but not less than 1 gallon of each material and color applied.
2. The material shall be delivered in unopened labeled containers as delivered from the manufacturer. Containers shall have typed labels indicating brand, type, color, texture, location used, etc.
3. Where multiple component materials are used, provide an unopened kit of the necessary materials in the manufacturer’s smallest standard packaging size. Provide three (3) copies of the manufacturer’s instructions describing the materials and directions for their use.
4. Provide a typed inventory list of the extra materials furnished at time of delivery.

1.9 SPECIAL WARRANTY

A. Warranty inspection of the coating systems shall be conducted during the eleventh month following completion and acceptance of all coating system work. The personnel or their representatives present at the pre-installation conference are requested to attend. Defective coating systems shall be repaired in accordance with this Section.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain the following:
    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.
    i. Di-n-octyl phthalate.
    j. 1,2-dichlorobenzene.
    k. Diethyl phthalate.
    l. Dimethyl phthalate.
    m. Ethylbenzene.
    n. Formaldehyde.
    o. Hexavalent chromium.
    p. Isophorone.
    q. Lead.
    r. Mercury.
    s. Methyl ethyl ketone.
    t. Methyl isobutyl ketone.

u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

2.2 COLOR SCHEDULE

A. Color Selection:
1. Colors: As selected by OWNER from manufacturer's full range of colors.
2. Colors selected may or may not be the manufacturer's standard color.
3. Submit color charts to OWNER at least 60 days prior to coating application to allow time for color selection.
4. Different colors will be selected for concrete structures; building columns, framing, walls, window and door frames, and other areas; various items of equipment; piping and conduit; safety colors will be used for fire equipment locations, protective covers for rotating or moving equipment, walkways, and other related items; architectural treatment, both interior and exterior of buildings; and for other items of work.
5. Colors for equipment shall be selected by OWNER during submittal process.

B. Colors selection for piping systems and identification of piping systems shall be in accordance with Section 10 90 00 "Identification, Stenciling, and Tagging." Refer to Piping and Sign Color Code included in this Section for colors for lettering, piping, and background.

2.3 MANUFACTURERS

1. Acceptable Manufacturers: Provide coating products from one of the manufacturers listed, if not listed under each Painting System Application:
1. Carboline Protective Coatings and Linings, St. Louis, MO.
2. PPG Protective and Marine Coatings (formerly Ameron Coatings).
3. Tnemec Company, Inc., Kansas City, MO.

2.4 MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

B. CONTRACTOR shall have complete responsibility for ensuring that each coating applied is compatible with its substitute and/or its intended finish coat, and that the completed coating system is suitable for its intended service.

C. Accessory Materials: Thinning of paint and accessory type materials used shall be strictly in accordance with the manufacturer's recommendations covering material types, solvents, mix ratios, and methods.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with APPLICATOR present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Masonry (Clay and CMU): 12 percent.
   3. Wood: 15 percent.
   4. Gypsum Board: 12 percent.
   5. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes CONTRACTOR's acceptance of substrates and conditions.

3.2 PREPARATION

A. Surface of substrates to be coated shall be prepared in accordance with the SSPC specification as listed in Part 3.6 and as described in the paragraphs below.

B. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

C. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
   2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove unknown primers or coating systems and incompatible primers of shop painted work and reprime substrate with compatible primers as required to produce paint systems indicated.
      a. When removal is not feasible and with approval of ENGINEER, CONTRACTOR may apply a sealer in accordance with coating manufacturer’s instructions prior to application of the designated coating system.
   2. When sandblasting, use a source of compressed air, which is free of detrimental water and oil and capable of delivering the required volume and pressure.
   3. Subject to review by ENGINEER, any substrate in which SSPC-SP6 or SSPC-SP10 sandblasting cannot be accomplished shall be cleaned in accordance with SSPC-SP3 removing loose mill scale, rust, paint, and other foreign matter.

E. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
   1. Allow new concrete to cure for 28 days.

F. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceeds that permitted in manufacturer's written instructions.

G. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

H. Steel Substrates: Remove rust and loose mill scale if work has not been shop-primed with coating system compatible primer. Clean using methods recommended in writing by paint manufacturer.

I. 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 paints.

J. Aluminum Substrates: Remove surface oxidation.

K. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

L. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

M. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

N. Spray-Textured Ceiling Substrates: Do not begin paint application until surfaces are dry.

O. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by work of this Section.

C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

D. Remove empty paint containers from site and dispose of excess materials and empty containers in full accordance with applicable state, federal, and local laws.

3.4 APPLICATION

A. Minimum Dry Film Thickness (MDF). Where applicable, the Coating Schedule includes the minimum dry film thickness required for the various coating systems specified. The film thickness is measured in mils.

B. Apply products in accordance with manufacturer's instructions regarding drying time between coats, technique of application, ventilation, paint thinning, and safety precautions.

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

C. Allow applied coat to dry for the time period specified by the coating manufacturer before next coat is applied. Do not apply finishes to surfaces that are not dry to touch.

D. Apply each coat to uniform finish free from runs, drips, ridges, waves, laps, brush marks and variations in color, texture and finish.

E. Where multiple coats are specified, apply each coat in a different color, which compliments the following coat and is different than the proceeding coat. Each coat must be free of shadows and uniform in appearance.

F. Sand lightly between coats to achieve required finish.

G. Double-lap welds. Apply prime coat by brush to weld areas, then apply prime coat to entire surface, including weld areas.

H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

I. Prime back surfaces of interior and exterior woodwork with primer paint.

J. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

K. Paint items throughout the project except for surfaces listed below unless shown otherwise in the plans or specifications:
1. Concrete walkways, pavement, sidewalks, and stair treads.
2. Interior fiberglass items unless specified otherwise. Exterior fiberglass shall be painted.
3. Metal surfaces of anodized aluminum, stainless steel, or chromium plate.
4. Operating parts, unless otherwise specified.
5. Existing structures or equipment, unless otherwise specified.
6. Equipment, valve, and other items nameplates or serial numbers.
7. Valve operator stems.

L. Repair damage or overspray to paint on existing structures caused by construction work. Match existing colors with touch-up paint.

M. New concrete and rubbed finish and mortar joints shall age a minimum of 30 days before application of coatings.

N. Concrete surfaces to be painted shall be coated prior to installation of equipment, piping, conduit and supports and touched up following installation of these items. Components, which cannot be adequately painted due to space limitations following installation, shall be coated prior to installation, and touched up after installation as well.

O. Where inspection shows that the specified thickness is not developed, apply additional coats in accordance with manufacturer's instructions and cure schedule requirements to produce the required dry film thickness.

3.5 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Refer to Section 10 90 00 “Identification, Stenciling, and Tagging” for requirements for color-coding and identification banding of ductwork, piping, conduit, and identification systems.

B. Paint shop primed equipment. Touch-up paint equipment furnished with factory coatings with manufacturer’s correct color.

C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports. For insulated pipe, provide shop and field primer coats on pipe and surface preparation and final coat on insulation jacket.

E. Replace identification markings on mechanical or electrical equipment when painted accidentally.

F. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

G. Paint exposed conduit and electrical equipment occurring in finished areas.

H. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

I. Color code equipment, piping, conduit, and exposed ductwork in accordance with requirements indicated. Color band and identify with flow arrows and names.

J. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

K. Coating systems applied at the factory shall be protected against damage during transit, delivery, storage, and erection. Damaged areas shall be refinished as the original so that the finish will be in perfect shape at the end of the Project.

1. The following items shall receive factory applied coatings:
    a. Electrical panels, motor control centers, transformers, and related items.
    b. Light fixtures.
    c. Pressure gauges.
    d. Instrumentation.

3.6 SURFACE PREPARATION AND COATING SCHEDULE

A. Cast-in Place Concrete Walls and Ceilings, Precast Concrete Surfaces, Equipment Bases, Pipe Supports, and Similar Surfaces, with "smooth rubbed finish," Interior, Non-submerged, where painting is specified:

1. Surface preparation: SSPC-SP13, Surface Preparation of Concrete. Prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Abrasive blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers and other contaminants and to provide an ICRI-CSP 2-3 surface profile.

2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: Series 66 Hi-Build Epoxoline - 1 coat, 5.0 MDF.
        2) Finish: Series 66 Hi-Build Epoxoline - 1 coat, 4.0 MDF.
    b. Carboline:
        1) Primer: Carboguard 890 - 1 coat, 5.0 MDF.
        2) Finish: Carboguard 890 - 1 coat, 4.0 MDF.
    c. PPG:
        1) Primer: Amerlock 2/400 - 1 coat, 5.0 MDF.
        2) Finish: Amerlock 2/400 - 1 coat, 4.0 MDF.

B. New and Existing Concrete, Exposed, Exterior, Not Submerged or Not Intermittently Submerged where painting is required:
    1. Surface Preparation: SSPC-SP13, Surface Preparation of Concrete.
    2. Product and Manufacturer:
        a. Tnemec:
            1) Primer: Series 156 Enviro-Crete - 1 coat, 7.0 MDF.
            2) Finish: Series 156 Enviro-Crete - 1 coat, 7.0 MDF.
        b. Carboline:
            1) Primer: 954HB - 1 coat, 120 square feet per gallon.
            2) Finish: 954HB - 1 coat, 9.0 MDF.
        c. PPG:
            1) Primer (Existing Concrete): Perma-Crete 4-603XI - 1 coat, 7.0 MDF.
            2) Primer (New Concrete): Perma-Crete Pitt-Flex 4-110XI - 1 coat, 7.0 MDF.
            3) Finish: Perma-Crete Pitt-Flex 4-110XI - 1 coat, 7.0 MDF.

C. Concrete Block Walls and Cast-In-Place Concrete not conforming to smooth rubbed finish, Interior, where painting is specified:
    1. Surface Preparation: SSPC-SP13, Surface Preparation of Concrete.
    2. Product and Manufacturer: Provide one of the following:
        a. Tnemec:
            1) Primer: Series 130 Envirofill - 1 coat, 60-80 square feet per gallon
            2) Finish: Series 66 Hi-Build Epoxoline - 2 coats, 5.0 MDF per coat.
        b. Carboline:
            1) Primer: Carboguard 954HB - 1 coat, 85-125 square feet per gallon.
            2) Finish: Carboguard 890 - 2 coats, 5.0 MDF per coat.
        c. PPG:
            1) Primer: Amerlock 400BF, Epoxy Block Filler - 1 coat, 100 square feet per gallon.
            2) Finish: Amerlock 2/400 - 2 coats, 5.0 MDF per coat.

D. Concrete Floors, Walks, and Stairs, Interior, where painting is required:
    1. Surface preparation: Allow new mortar and masonry to cure 14 days. Level

protrusions and mortar spatter. Prepare and mechanically abrade by shot blasting according to SSPC-SP13/NACE 6 for “Severe Service,” providing a surface profile equal to ICRI CSP-3. Fill voids and bugholes with epoxy surface sealer (Tnemec Series 215 or ENGINEER approved equivalent by named manufacturers).

2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: Series 201 Epoxoprime - 1 coat, 6.0-10.0 MDF.
        2) Finish: Series 280 Tnemec-Glaze - 1 coat, 6.0-10.0 MDF. Add 5 pounds of 50 mesh dry wash silica sand to topcoat to provide a non-skid surface in walkway areas.
    b. Carboline:
        1) Primer: Carboseal 720 - 1 coat, 6.0-10.0 MDF.
        2) Finish: Carboseal 745 - 1 coat, 6.0-10.0 MDF with clean, dry sand broadcast into the film and back rolled to encapsulate.
    c. PPG:
        1) Primer: Flooring Concrete Epoxy Primer - 1 coat, 6.0-10.0 MDF.
        2) Finish: Flooring Self-Leveling Epoxy - 1 coat, 6.0-10.0 MDF. May add aluminum oxide broadcast to improve traction.
3. For walkway surfaces and stairs, provide a non-slip additive (Amercoat 886 manufactured by PPG or equivalent product).

E. Concrete Floors, Walks, and Stairs, Interior, where sealing is required:
1. PPG:
    a. Flooring Concrete Epoxy Primer - 1 coat, 6.0 MDF.
    b. Manufacturer's standard "water clear" emulsion-type breathing coating of acrylic resins (based on methyl methacrylate) in water recommended by manufacturer for application to interior concrete as a water-repellent coating; minimum 20 percent solids content.
    c. Ashford Formula manufactured by Cure-Crete Chemical Company to seal and harden concrete floor.
2. ENGINEER approved equivalent by Tnemec.
3. ENGINEER approved equivalent by Carboline.

F. Submerged or intermittently submerged Concrete, Interior and Exterior, except for potable water service, and where coatings are required.
1. Surface Preparation: Remove surface contaminants such as old coatings, loose concrete, chemical salts, dust, etc., by brush-blast cleaning; remove grease, oils, and grime by washing with an emulsifying alkaline base cleaner; follow with through rinsing in accordance with manufacturer’s instructions.
2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Finish: Series 46H-413 Tneme-Tar - 1 coat, 16.0 MDF
    b. Carboline:
        1) Finish: Bitumastic 300M - 2 coats, 8.0-10.0 MDF per coat.
    c. PPG:

1) Finish: Amercoat 78HB Coal Tar Epoxy - 1 coat, 16.0 MDF.

3. For walkway surfaces and stairs, provide a non-slip additive (Amercoat 886 manufactured by PPG or equivalent product).

G. Masonry, Exterior, where painting is required:

1. Surface Preparation: SSPC-SP7, Brush-Off Blast Cleaning.
2. Product and Manufacturer: Provide one of the following:
   a. Tnemec:
      1) Primer: Series 156 Enviro-Crete - 1 coat, 7.0 MDF.
      2) Finish: Series 156 Enviro-Crete - 1 coat, 7.0 MDF.
   b. Carboline:
      1) Primer: 954HB - 1 coat, 120 square feet per gallon.
      2) Finish: 954HB - 2 coats, 35-45 square feet per gallon depending on texture.
   c. PPG:
      1) Primer (Existing Concrete): Perma-Crete 4-603XI - 1 coat, 7.0 MDF.
      2) Primer (New Concrete): Perma-Crete Pitt-Flex 4-110XI - 1 coat, 7.0 MDF.
      3) Finish: Perma-Crete Pitt-Flex 4-110XI - 1 coat, 7.0 MDF.

H. Ferrous Steels including Structural Metal Bar Joists, Miscellaneous Metals and Piping, including piping to be insulated, Interior:

1. Surface Preparation: SSPC-SP6, Commercial Blast Cleaning.
2. Product and Manufacturer: Provide one of the following:
   a. All Manufacturers:
      1) Finish (If under insulation or at risk of being immersed): Tnemec Series 66 Hi-Build Epoxoline - 2 coats, 4.0-6.0 MDF per coat (or ENGINEER approved equivalent by named manufacturers). Otherwise not required.
   b. Tnemec:
      1) Shop Primer: Series 90G-1K97 Tneme-Zinc - 1 coat, 2.5-3.5 MDF.
      2) Shop Primer for Bar Joists: Series 90G-1K97 Tneme-Zinc - 1 coat, 2.5-3.5 MDF.
      3) Field primer or field touch-up: Series 90G-1K97 Tneme-Zinc - 1 coat, 2.5-3.5 MDF.
      4) Finish: Series 66 Hi-Build Epoxoline - 2 coats, 4.0-6.0 MDF per coat.
   c. Carboline:
      1) Shop primer for bar joists, field primer or touch-up: Rustbond Penetrating Sealer - 1 coat, 2.0 MDF.
      2) Finish: Carboguard 890 - 2 coats, 4.0-6.0 MDF per coat.
   d. PPG:
      1) Shop primer: Amerlock Sealer if unknown OEM coating. Others: Amerlock 400 - 1 coat, 6.0 MDF.
      2) Shop primer for Bar Joists, Field, or Field touch-up is the same as the shop primer.

I. Ferrous Metals Encased in Concrete, Plaster, Fireproofing and Similar Materials:

1. Surface preparation: SSPC-SP6, Commercial Blast Cleaning.
2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Shop Primer and Field Touch-up: Series 66 Hi-Build Epoxoline - 1 coat, 4.0-6.0 MDF.
    b. Carboline:
        1) Shop Primer and Field Touch-up: Carbocoat 150 Universal Primer - 1 coat, 4.0-6.0 MDF.
    c. PPG:
        1) Shop Primer and Field Touch-up: Amercoat 385 - 1 coat, 4.0-6.0 MDF.
3. Verify the compatibility of primer with fireproofing manufacturer.

J. Ferrous Metals, Interior and Exterior, Submerged or Intermittently Submerged, except in potable water:
1. Surface Preparation: SSPC-SP10, Near-White Blast.
2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Shop Primer: Series 94-H2O Hydro-Zinc - 1 coat, 2.5-3.5 MDF.
        2) Stripe Coat: Series 20 Pota-Pox applied by brush and scrubbed into weld seams. In addition to weld seams, edges, corners bolts, rivets, pits, etc. shall receive a stripe coat.
        3) Finish: Series 141 Epoxoline - 1 coat, 12.0-15.0 MDF.
    b. Carboline:
        1) Shop Primer: Not needed.
        2) Finish: Carbomastic 890 - 2 coats, 12.0-15.0 MDF per coat.
    c. PPG:
        1) Shop Primer: Optional
        2) Finish: Amerlock 2/400 - 2 coats, 12.0-15.0 MDF per coat.

K. All surfaces in contact with potable water:
1. Surface Preparation:
    a. Steel, submerged or intermittently submerged:
        1) Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard SP0178, Designation D.
        2) Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning. Anchor profile shall be angular with a 3.0 mil profile as per ASTM D 4417, Method C or NACE Standard RP0287.
    b. Ductile iron pipe, submerged or intermittently submerged:
        1) Clean all surfaces as per NAPF 500-03-01 Solvent Cleaning to remove all oil, grease, factory-applied tars and/or bitumastic coatings and all other soluble contaminants.

2) Prepare ductile iron pipe as per NAPF 500-03-04 Abrasive Blast Cleaning for Ductile Iron Pipe providing a minimum 1.5 mil angular anchor profile.

3) Prepare ductile iron valves and fittings as per NAPF 500-03-05 Abrasive Blast Cleaning for Cast Ductile Iron Fittings.

4) If existing ductile is factory coated with Tnemec Series N140, follow the manufacturer's recoat instructions.

c. Concrete: Prepare new and existing concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Abrasive blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers and other contaminants and to provide a minimum ICRI-CSP 5 surface profile. Fill voids and bugholes with epoxy surface sealer (Tnemec Series 215 or ENGINEER approved equivalent by named manufacturers).

2. Products and Manufacturer (only use products certified to NSF/ANSI Standard 61):

a. Tnemec:

1) Resurfacer:

a) Concrete: Tnemec Series 218 MortarClad applied at a minimum 1/8".

2) First Coat:

a) Steel/Ferrous Metals: Series N140 Pota-Pox Plus applied at 3.0-5.0 dry mils.

b) Concrete: Tnemec Series N140 Pota-Pox Plus applied at 5.0 to 8.0 dry mils.

3) Stripe Coat:

a) Steel/Ferrous Metals: N140 Pota-Pox Plus applied by brush to all weld seams, edges, corners, rivets, nuts, bolts, washers, etc.

4) Second Coat:

a) Steel/Ferrous Metals: Tnemec Series 22 Epoxoline applied at 20.0 to 40.0 dry mils. Second coat shall be certified to both NSF/ANSI Standard 61 and NSF/ANSI 600.

b) Concrete: Tnemec Series 22- Epoxoline applied at 20.0 to 40.0 dry mils. Second coat shall be certified to both NSF/ANSI Standard 61 and NSF/ANSI 600. Coat color shall match existing coating color.

5) Total Minimum Dry Film Thickness:

a) Steel/Ferrous Metals: 23 mils.

b) Concrete: 25 mils.

b. Or ENGINEER approved equivalent by named manufacturers.

L. Ferrous Metals, Exterior:

1. Shop Surface Preparation: SSPC-SP6, Commercial Blast Cleaning. Anchor profile shall be 1.5 to 2.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287.

2. Field Surface Preparation: Sandblasting of field welds and other imperfections. ENGINEER may require areas to be blasted at their discretion, in accordance with SSPC-SP6, Commercial Blast Cleaning.

3. Products and Manufacturer: Provide one of the following:

a. Tnemec:

1) Shop Primer: Series 90G-1K97 Tneme-Zinc - 1 coat, 2.5-3.5 MDF.
2) Field Primer: Series 90G-1K97 Tneme-Zinc - 1 coat, 2.5-3.5 MDF.
3) Second Coat: Series 66 Hi-Build Epoxoline - 1 coat, 3.0-5.0 MDF.
4) Finish: Series 290 CRU - 1 coat, 2.0-3.0 MDF.
5) Total Minimum DFT: 7.5 mils

b. Carboline:
1) Shop Primer: Carboline 893 - 1 coat, 3.0 MDF.
2) Field Primer: Carboline 893 - 1 coat, 3.0 MDF.
3) Finish: Carbothane 134 HG - 2 coats, 3.0 MDF per coat.

c. PPG:
1) Shop Primer: Amercoat 133 applied at 10.0-12.0 MDF.
2) Finish Coat: Amercoat 133 applied at 10.0-12.0 MDF.

M. Galvanized Metal and Non-Ferrous Metal, Interior:
1. Surface Preparation: SSPC-SP1, Solvent Cleaning, followed by SSPC-SP16, Sweep Blasting.
2. Product and Manufacturer: Provide one of the following:
a. Tnemec:
1) Primer: Series 115 Uni-Bond DF - 1 coat, 2.0-4.0 MDF.
2) Finish: Series 115 Uni-Bond DF - 1 coat, 2.0-4.0 MDF.

b. Carboline:
1) Finish: Carboguard 890 - 1 coat, 5.0 MDF.

c. PPG:
1) Finish: Amercoat 385 Polyamide Epoxy - 1 coat, 5.0 MDF.

N. Galvanized Metal and Non-Ferrous Metal, Exterior, where painting is required:
1. Surface Preparation: SSPC-SP1, Solvent Cleaning, followed by SSPC-SP16, Sweep Blasting.
2. Product and Manufacturer: Provide one of the following:
a. Tnemec:
1) Primer: Series 115 Uni-Bond DF - 1 coat, 2.0-4.0 MDF.
2) Finish: Series 1028 Enduratone - 1 coat, 2.0-3.0 MDF.

b. Carboline:
1) Primer: Carboline 893 - 1 coat, 4.0 MDF.
2) Finish: Carboline 134 - 1 coat, 1.5 MDF.

c. PPG:
1) Primer: Amerlock 2/400 - 1 coat, 4.0 MDF.
2) Finish: Pitthane Ultra High Solids Aliphatic Polyurethane - 1 coat, 1.5 MDF.

O. Galvanized Ferrous Metal, Interior, Non-Ferrous Metal Submerged or Intermittently Submerged:
1. Surface Preparation: SSPC-SP1, Solvent Cleaning, or hand tool clean, followed by SSPC-SP16, Sweep Blasting.

2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: 66-1211 Epoxoline Primer - 1 coat, 4.0 MDF.
        2) Finish: Series 66 Hi-Build Epoxoline - 1 coat, 4.0 MDF.
    b. Carboline:
        1) Primer: Carboguard 890 - 1 coat, 4.0 MDF.
        2) Finish: Carboguard 890 - 1 coat, 4.0 MDF.
    c. PPG:
        1) Primer: Amerlock 2/400 - 1 coat, 4.0 MDF.
        2) Finish: Amerlock 2/400 - 1 coat, 4.0 MDF.
3. Brush weld seams, rivets, bolts, and nuts, etc. with 50 percent thinned solution prior to first full coat.

P. Insulated Ferrous Metal Pipe, Interior, Temperatures Below 200 Degrees F:
1. Surface Preparation: SSPC-SP1, Solvent Cleaning, followed by SSPC-SP10, Near-White Blast Cleaning.
2. Products and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: Series 1 Omnithane - 1 coat, 2.5 MDF.
        2) Finish: Series 66 Hi-Build Epoxoline - 2 coats, 4.0 MDF.
    b. Carboline:
        1) Primer: Carboguard 890 - 1 coat, 4.0 MDF.
        2) Finish: Carboguard 890 - 2 coats, 4.0 MDF.
    c. PPG:
        1) Finish: Amerlock 2 Epoxy - 2 coats, 6.0 MDF per coat.

Q. All Metal Surfaces Exposed to Temperatures Over 250 Degrees F
1. Surface Preparation: SSPC-SP10, Near-White Blast Cleaning.
2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: Series 1501 Endura-Heat Primer - 1 coat, 2.0-3.0 MDF.
        2) Finish: Series 1552 Endura-Heat - 1 coat, 2.0-3.0 MDF
    b. Carboline:
        1) Primer: Thermaline 4700 - 1 coat, 1.5-2.0 MDF (not insulated) or Thermaline 450 EP Red or Gray - 1 coat, 4.0-8.0 MDF (if insulated).
        2) Finish: Thermaline 4700 - 1 coat, 1.5-2.0 MDF (not insulated) or Thermaline 450 EP Red or Gray - 1 coat, 4.0-8.0 MDF (if insulated).
    c. PPG:
        1) Primer: Amerlock 2 - 1 coat, 6.0 MDF (not insulated).
        2) Intermediate: Amerlock 2 - 1 coat, 6.0 MDF (if insulated).
        3) Finish: Hi-Temp 500 - 1 coat, 1.0 MDF (optional).

R. All Aluminum in Contact with Dissimilar Materials:

1. Surface Preparation: Remove foreign matter.
2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Series 66 Hi-Build Epoxoline - 2 coats, 4.0 MDF per coat
    b. Carboline:
        1) Carboline 893 - 2 coats, 4.0 MDF per coat.
    c. PPG:
        1) Amerlock 2/400 - 2 coats, 4.0 MDF per coat.

S. Mill-Coated Steel Pipe (Exterior):
1. Surface Preparation: SSPC-SP10, Near-White Blast Cleaning.
2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: Series 90G-1K97 Tneme-Zinc - 1 coat, 2.5-3.5 MDF.
        2) Stripe Coat: Series 66 Hi-Build Epoxoline applied by brush and scrubbed into weld seams. In addition to weld seams, edges, corners, bolts, rivets, pits, etc. shall receive a stripe coat.
        3) Second Coat: Series 66 Hi-Build Epoxoline - 1 coat, 4.0-6.0 MDF.
        4) Finish: Series 290 CRU - 1 coat, 2.0-3.0 MDF.
    b. Carboline:
        1) Primer: Carboguard 893 - 1 coat, 4.0 MDF.
        2) Finish: Carboguard 890 - 1 coat, 4.0 MDF.
        3) Exterior Finish: Similar to Tnemec.
    c. PPG:
        1) Primer: Amerlock 2/400 - 1 coat, 6.0 MDF.
        2) Finish: Amercoat 2/400 - 1 coat, 6.0 MDF (if insulated).
        3) Exterior Finish: Pitthane Ultra - 1 coat, 1.0 MDF.

T. Plaster and Dry Wall Interior:
1. Surface Preparation: Sand and seal.
2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: 51-792 PVA Sealer - 1 coat, 1.0 MDF.
        2) Finish: Series 1029 Enduratone - 2 coats, 2.0-3.0 MDF per coat.
    b. Carboline:
        1) Primer: Carboline 120 - 1 coat, 1.0 MDF.
        2) Finish: Carboguard 890 - 2 coats, 4.0 MDF per coat.
    c. PPG:
        1) Primer: Amerlock 400 High-Solids Epoxy Coating - 1 coat, 4.0 MDF.
        2) Finish: Amerlock 400 High-Solids Epoxy Coating - 2 coats, 4.0 MDF per coat.

U. Wood Surfaces, Interior and Exterior:
1. Surface Preparation: Sand rough areas smooth. Seal knots and pitch pockets. Fill

cracks and nail holes after primer is dry. Surfaces must be dry, clean, and free of oil, grease, dust, dirt, and other contaminants.

2. Product and Manufacturer: Provide one of the following:
    a. Tnemec:
        1) Primer: Series V10 Primer - 1 coat, 2.0-3.0 MDF.
        2) Intermediate Coat: Series 1029 Enduratone - 1 coat, 2.0-3.0 MDF.
        3) Finish Coat: Series 1029 Enduratone - 1 coat, 2.0-3.0 MDF.
    b. Carboline:
        1) Primer: Carbocrylic 120 - 1 coat, 2.0 MDF.
        2) Finish: Carbocrylic 3359 - 2 coats, 2.5 MDF per coat.
    c. PPG:
        1) Primer: Seal Grip Acrylic Primer - 1 coat, 1.5 MDF.
        2) Finish: Pitt-Tech Plus - 2 coats, 2.0 MDF per coat.

V. Exposed Non-insulated PVC Piping and FRP Components, Interior and Exterior where painting is required.
    1. Surface Preparation: As recommended by coating manufacturer.
    2. Product and Manufacturer: Provide one of the following:
        a. Tnemec:
            1) Finish: Series 66 Hi-Build Epoxoline - 1 coat, 4.0 MDF.
        b. Carboline:
            1) Finish: Carboguard 890 - 1 coat, 4.0 MDF.
        c. PPG:
            1) Finish: Amerlock 2/400 - 1 coat, 4.0 MDF.
    3. A second finish coating of epoxy urethane, 3.0 MDF, shall be applied on exterior PVC and FRP components (Tnemec Series 1074 Endura-Shield or PPG Pitthane Ultra 95-812 or ENGINEER approved equivalent by other named suppliers).

W. Metal Pipe, Interior and Exterior, with Temperatures up to 250 degrees F:
    1. Surface Preparation:
        a. Immersion Service:
            1) SSPC-SP10, Near-White Blast Cleaning.
        b. Non-Immersion Service
            1) SSPC-SP6, Commercial Blast Cleaning.
    2. Products and Manufacturer: Provide one of the following:
        a. Exterior Surfaces:
            1) Tnemec:
                a) Primer: Series 66 Hi-Build Epoxoline - 1 coat (non-insulated) or 2 coats (insulated), 4.0 MDF per coat.
                b) Finish: Series 66 Hi-Build Epoxoline - 1 coat, 5.0 MDF.
                c) Finish (UV Exposure): Series 1074 Endura-Shield - 1 coat, 4.0 MDF.
            2) Carboline:
                a) Primer: Carboline 893 - 1 coat (non-insulated), 2 coats (insulated),

3.0 MDF per coat.

b) Finish: Carboguard 890 - 1 coat, 4.0 MDF.

c) Finish (UV Exposure): Similar to TNEMEC above.

3) PPG:

a) Primer/Finish: Amerlock 2 High Solids Epoxy Coating - 1 coat (non-insulated) or 2 coats (insulated), 6.0 MDF per coat.

b) Finish: Amerlock 2 High Solids Epoxy Coating - 1 coat, 6.0 MDF.

c) Finish (UV Exposure): Pitthane Ultra - 1 coat, 2.0 MDF.

b. Interior Surfaces (SP10 Surface Preparation):

1) Tnemec:

a) Primer: Series 120-5002 - 1 coat, 15.0 MDF.

b) Finish: Series 120-5001 - 1 coat, 15.0 MDF.

2) PPG:

a) Primer: Amerlock 2 - 1 coat (non-insulated) or 2 coats (insulated), 6.0 MDF per coat.

3) Or ENGINEER approved equivalent by named manufacturers.

3.7 FIELD QUALITY CONTROL

A. CONTRACTOR shall be responsible for the following testing during coating operations:

1. Prior to start and during the coating application each day, temperature and humidity readings will be obtained. If the values obtained are not within the recommended temperature and humidity range described herein or as required by the coating manufacture, the coating application will not be allowed.
2. Periodically check the wet film thickness during coating applications.
3. Prepared records of the above tests and readings.

B. Testing Agency: OWNER will engage a qualified testing agency to perform tests and inspections.

1. Minimum Dry Film Thickness (MDF) readings will be obtained after each coat of paint has been applied, and after final coat has been applied. A test will be made for every 25 square feet of surface and at locations designated by the ENGINEER. A minimum of three readings of the area around the location will be obtained. If the average of these readings indicates the MDF for the final coat is below the specified minimum, CONTRACTOR shall apply another coat in accordance with the manufacturer's instructions.
2. The interiors of liquid containing structures and tanks will be tested for holidays after final coat application. Areas found to be defective shall have an additional coat applied.

C. The coating system will be considered defective if it does not pass tests and inspections. When this occurs, the ENGINEER will specify corrective measures. The coating system will be retested, with the additional expense occurred charged to the CONTRACTOR. Refer to 01 40 00 "Quality Requirements" for addition information regarding retesting and reinspection and 01 70 00 "Execution Requirements" for correction of work.

D. Testing of Paint Materials: OWNER reserves the right to invoke the following procedure at any time and as often as OWNER deems necessary during the period when paints are being

applied:

1. OWNER will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of CONTRACTOR.
2. Testing agency will perform tests for compliance of paint materials with product requirements.
3. OWNER may direct CONTRACTOR to stop applying paints if test results show materials being used do not comply with product requirements. CONTRACTOR shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. CONTRACTOR will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

E. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

E. During progress of work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

F. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

G. Upon completion of the work remove staging and scaffolding. Dispose of sand, containers, and rubbish in a suitable manner. Remove overspray, paint spots, oil, or stains on adjacent surfaces. Leave the entire Project clean and acceptable.

END OF SECTION

SECTION 40 05 91
COMMON CONTROL PANEL REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Where specified in the equipment manufacturer's specification, the equipment manufacturer's shall furnish a fully functional industrial control panels to manually and automatically operate equipment as specified in the detailed requirements of the equipment sections of Division 40s, and supplemented with logic and schematics diagrams as shown on the Electrical and Instrumentation Drawings.

B. It is the intent of these specifications to have all starters, VFDs, breakers, control panel devices relays, PLC if required and signal conditioning components included within their respective control panels. The equipment supplier shall be responsible for final sizing of enclosures to meet the clearance requirements of NFPA 70 and NFPA 79 and as specified herein. Should the equipment supplier submit a panel size and layout that is, in the opinion of the OWNER or the ENGINEER, insufficient in size to meet these requirements, the submittal will not be approved and will be returned for revision and resubmission. The equipment supplier shall be required to revise the panel size and layout and resubmit for approval at no additional cost to the OWNER.

C. All enclosures and panel components shall be of the same manufacture wherever possible.

D. Installation and configuration of network infrastructure cabling and equipment shall be a cooperative and coordinated effort between OWNER, the CONTRACTOR, and the Control System Integrator. The Equipment Supplier and the Control System Integrator shall furnish all labor necessary for the installation and testing as required to fully meet the applicable specifications of the Contract Documents.

E. All equipment, field devices and instruments shall utilize tags names as shown on Contract Documents.

F. All Industrial Control Panels shall have a UL 508A label affix to the inside of the panel. Those panels with equipment or instrumentation is Class I, Division I areas shall also comply with UL 698.

G. Related Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.

1.2 REFERENCES - NOT USED

1.3 ADMINISTRATIVE REQUIREMENTS - NOT USED

1.4 SUBMITTALS

A. Comply with the submittal requirements of Section 01 30 00 - Administrative Requirements, Individual Equipment Specifications, and as described below.

B. Product Data: For each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Panel Layout Drawings and Wiring Diagrams Submittal

1. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11x17 inches in size. At a minimum, the panel drawings shall include the following:
    a. Interior and exterior panel elevation drawings to scale.
    b. Nameplate schedule.
    c. Conduit access locations.
    d. Panel construction details.
    e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
    f. Fabrication and painting specifications including color (or color samples).
    g. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
    h. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
    i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Control System Integrator.
2. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the equipment supplier. Wiring labeling used on the drawings shall match that shown on the Contract Documents. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11x17 inches in size.
3. ISA Loop Wiring Diagrams: Individual wiring diagram for each field device or instrument shall be required. Loop diagrams shall comply with the minimum requirements of ISA S5 4. Drawings shall be 11x17-inch sheets for each device. Divide

loop diagram into areas for panel face, back-of-panel, and field. Show the terminal numbers, location of dc power supply, switching contacts in analog loops and output contacts of analog devices. Show circuit and raceway schedule names and terminal numbers. Drawings shall show electrical connections between equipment, consoles, panels, terminal junction boxes, and field mounted instruments. Component and panel terminal board identification numbers and external wire and cable numbers shall be shown. Circuit names shall match Circuit and Raceway Schedule. Intermediate terminations between field elements and panels to terminal junction boxes and pull boxes shall be shown. Diagrams shall bear Subcontractor signature attesting diagrams have been coordinated with electrical drawings.

D. Memory Map: Submit memory map of PLC or Controller registers to be transmitted to Plant Control System.

E. Operation and Maintenance Data: For control panels, installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 - Operation and Maintenance Data, include the following:

F. Routine maintenance requirements for control panels and all installed components.

G. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

H. Final As-Built drawing shall be supplied in AutoCAD format, utilizing AutoCAD’s etransmit feature, for use by the OWNER in modifying panels for future expansion or required modifications.

I. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

J. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

K. Configuration Settings: Compile after panel has been installed and tested, all configuration or program settings, of VFDs, meters, controllers, timers, etc. in documentation format.

1.5 QUALITY ASSURANCE

A. The manufacturer of the control panels shall have produced similar equipment for a minimum period of five years. When requested by the ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The control panels shall be assembled in a UL 508 certified facility. A submittal of documentation certifying that the panel fabrication facility is a UL 508 certified facility is required.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. Control panels submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Completed industrial control panels and related equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at the time of shipment, and shall be made available to the general CONTRACTOR, the OWNER, and ENGINEER.

B. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Accessories shall be packaged and shipped with each panel.

C. Visible shipping damage to any portion of a shipment shall be assumed to have also damaged the surrounding portion. The visibly damaged and the surrounding panels shall be returned to the manufacture's UL 508 facility for examination and damaged equipment replaced.

D. Industrial Control Panels shall be installed in their permanent finished location shown on the drawings within 7 calendar days of arriving onsite. If the equipment cannot be installed within 7 calendar days, the equipment shall not be delivered to the site, but stored offsite, at the CONTRACTOR’s expense, until such time that the site is ready for permanent installation of the equipment or within ENGINEER-approved on-site storage facilities.

E. Space heaters shall be furnished in industrial control panels and the CONTRACTOR shall provide temporary electrical power and operate space heaters during storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.7 SITE CONDITIONS - NOT USED

1.8 WARRANTY

A. Extended Equipment Warranty: Refer to Section 01 78 36 - Warranties for extended equipment warranty.

B. All equipment furnished under this section shall have a special equipment warranty, in accordance with the Contract Documents, for a period of two (2) years after the date of Substantial Completion. The cost of removal, shipment, repair, and installation by CONTRACTOR shall be included in the warranty and correction of defective work.

PART 2 - PRODUCTS

2.1 RATINGS

A. The service voltage shall be as specified and as shown on the Drawings. The overall short circuit withstand and interrupting rating of the equipment and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the Control Panel, but not less than 22,000 Amps rms symmetrical at 480/277 Vac, 480 Vac or 120 Volts per equipment specifications. This includes all circuit breakers and combination motor starters. Systems of motor controllers employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL 508A labeled for the specified short circuit duty in combination with the motor branch circuit protective device.

B. There shall be selective device coordination between the Main Breaker, Feeder Breakers and control circuit protective devices. When using a circuit breaker or fuses as a main protective device, the instantaneous trip levels of the main protective device shall be higher

than the available fault current to the control panel. If fuses are utilized in the control panel design, the protective devices for 3-phase loads shall contain single phase protection of such equipment. If a fault occurs in the circuit of one load of a design with a backup load, the feeder protective device shall not remove both loads from the control system.

C. Use ground fault sensing on grounded wye systems.

D. The complete control panel assembly shall be UL-certified or carry a UL listing for "Industrial Control Panels".

E. The control panel shall meet all applicable requirements of the National Electrical Code.

F. The control panel enclosure shall be NEMA rated as specified herein.

G. Motor controllers, including associated devices, shall be designed for continuous operation at rated current in a 40°C ambient temperature.

H. For additional ratings and construction notes, refer to the mechanical equipment specifications and the Drawings.

I. The manufacturer shall produce and install on each panel, an Arc Flash Warning Label listing the various Flash Hazard Protection Boundaries, calculated from NFPA 70E, Annexes, as listed below:

1. Flash Hazard Protection Boundary.
2. Limited Approach Boundary.
3. Restricted Boundary.
4. Prohibited Boundary.
5. Incident Energy Level.
6. Required Personal Protective Equipment Class.
7. Type of Fire Rated Clothing.

J. Provide an Arc Flash Warning Label, printed in color and affixed to the front of each panel provided. Size of each label shall be not less than 8 inches wide and 6 inches tall.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, have been named within the various paragraphs of this Section.

B. The listing of specific manufacturers within the various paragraphs of this Section does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed within the various paragraphs of this Section are not relieved from meeting these specifications in their entirety.

2.3 GENERAL REQUIREMENTS

A. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. The devices designated for rear-of-panel mounting shall be arranged within the panel in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as

power supplies shall be located at or near the top of the panel.

C. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and equipment supplier's data.

D. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

E. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

F. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to 3 lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).
2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black against a White background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless-steel screws for cabinet mounted nameplates
4. For every panel, provide a panel nameplate with a minimum of 1-inch high letters. Provide legend plates or 1x3-inch engraved nameplates with 1/4-inch lettering for identification of door mounted control devices, pilot lights, and meters.
5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

2.4 PANEL REQUIREMENTS

A. Structure and Enclosure

1. Panels shall be of continuous welded-steel construction. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.
2. Each panel shall be provided with full height, fully gasketed access doors where

shown. Doors shall be provided with a three-point stainless steel latch and heavy-duty stainless-steel locking handle. Rear access doors (if included) shall be conveniently arranged and sized such that they extend no further than 24 inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.

3. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.

4. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

5. All panels in indoor, environmental controlled environments (air conditioned) shall be NEMA 12 unless otherwise noted. All panels installed indoors, in non-environmental controlled environments or panels installed in outdoors shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

B. Freestanding and Floor-Mounted Vertical Panels

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of 12-gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of type 304 stainless steel, unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10-gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Support Channel Mounted Panels

1. All wall and support channel mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not less than USS 14-gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of type 304 stainless steel with white polyester powered coated paint, factory applied from the manufacturer, unless FRP is specifically indicated.

D. Finish Requirements

1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with 2 rust resistant phosphate prime coats and 2 coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum panels will not require a paint finish.

2. The panels shall have edges ground smooth and shall be sandblasted and then

cleaned with a solvent. Surface voids shall be filled and ground smooth.

3. Immediately after cleaning, 1 coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and topcoat of a 2-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.
4. Apply a minimum of 2 coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.
5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.
6. NEMA 4X Stainless Steel panels installed outdoors shall have an additional requirement of white polyester powered coated paint, factory applied from the manufacturer.

E. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5x11 inch documents without folding.

F. Folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 lbs. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.5 ENVIRONMENTAL CONDITIONING

A. Condensation Control

1. A self-contained enclosure condensation heater with thermostat and fan shall be mounted inside the control panel, if panel is mounted outdoors or in a non-air-conditioned space.
    a. Enclosure heaters shall be energized from 120 V, single-phase power supply and sized to prevent condensation within the enclosure.
    b. Locate enclosure heaters to avoid overheating electronic hardware or producing large temperature fluctuations on the hardware.
    c. Enclosure heaters shall have an internal fan for heat distribution and shall be controlled with adjustable thermostats. The thermostat shall have an adjustment range of 40-90°F. Provide a circuit breaker or fused disconnect switch within the enclosure.
    d. Enclosure heaters shall be Hoffman type DAH or equal.
2. Strip heaters may be provided if they are 240 V rated, powered at 120 Vac and do not have a surface temperature higher than 60°C. Strip heaters and thermostats shall be as manufactured by Chromalox or equal.
    a. Strip heaters shall be Chromalox, Type OT, 1.5 inches wide, 240 V, single phase, 150 W, energized at 120 V, with rust resisting iron sheath, Catalog No. OT-715,

Product Code No. 129314, or equal. Provide sufficient wattage in heaters to prevent condensation should the interior temperature of the enclosure drop below the dew point.

b. A control thermostat mounted inside the control Panel shall be Chromalox, Type WR, single stage, Catalog No. WR-80, Product Code No. 263177, or equal.

c. The strip heater terminals shall be guarded by a protective terminal cover.

d. High temperature connecting lead wire shall be used between the thermostat and the heater terminals. Wire shall be No. 12 AWG stranded, nickel-plated copper with Teflon glass insulation and shall be the product of Chromalox, Catalog No. 6-CFI-12, Product Code No. 263783, or equal.

3. Each panel shall have a 1/2-inch stainless steel condensate drain installed on a stainless-steel conduit hub, HGTZ Series, T&B or equal, in the bottom of the enclosure. Drain shall be O-Z Gedney DBB-50SS, or equal.

B. Panel Interior Ambient Control

1. The manufacturer shall provide ambient temperature control within the panel to maintain internal temperatures below the maximum operating temperatures of the panel components. An ambient temperature range of minus 20-40°C.

2. The manufacturer shall provide panel internal heat rise calculations to show that the panel internal temperatures will be maintained below the maximum operating temperatures of the panel components.

3. The calculation shall show all the internal and external heat gain loads, the expected internal temperature rise in °C above the specified ambient, If the specified temperature range cannot be met, an air conditioning system shall be provided with sufficient capacity to maintain the temperature within the specified limits. Panels, for which the calculated heat rise exceeds 40°C, shall have an air conditioning system sized as required to reduce the heat rise to 40°C or less, without violating the NEMA rating of the enclosure.

4. The air conditioner shall have the following features:

a. Use CFC-free R134a refrigerant.

b. Have fully gasketed flanges on all four mounting edges for a watertight seal that maintains NEMA 4X rating of the panel.

c. Thermostatic low temperature control to provide energy efficient operation and prevents over-cooling.

d. EMI/RFI suppressor to minimize transient spikes during compressor on/off cycling.

e. Separated blower-driven evaporator and condenser air systems for closed loop cooling.

f. UL listed.

g. Stainless steel enclosure.

h. Internal corrosion resistant coating.

i. Low ambient kit.

j. Short cycle protector.

k. The air conditioning unit shall be Hoffman, Thermo Electric or approved equal.

2.6 CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.7 INTERNAL POWER CIRCUIT DEVICES

A. Main Circuit Protective Device

1. Unless otherwise shown on the Drawings, the main circuit protective device shall be a molded case (MCCB), 3-Pole, 600 V, fixed type, manually operated with stored energy closing mechanism. Trip device shall be solid state with adjustable long time pickup and delay; adjustable short time pickup and delay; short time inverse time switch;
2. Provide a flange mounted main power disconnect operating handle with mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the "OFF" position. Where panels are shown or specified with inner and outer doors, disconnecting handles and controls shall be located on the inner door.

B. Motor Starter

1. Type:
   a. Magnetic Controller: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.
   b. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.
2. Contactors:
   a. Size contactors according to Drawings. Sizes below NEMA 1 are not acceptable. Provide three main poles, the number and type of auxiliary contacts to perform the required functions and two spare auxiliary contacts, one normally open and one normally closed, rated 10 Amps (NEMA contact rating designation A600).
   b. Use double break contacts of silver-cadmium oxide or similar material to minimize sticking or welding.
   c. Provide contactor coils suitable for continuous operation at 120 V, 60 Hz.
3. Unless otherwise indicated larger on the Drawings, use the following minimum starter sized for motor horsepower and voltage. Under no circumstances shall smaller sizes be used even if mistakenly shown on the Drawings; IEC starters and dual rated IEC/NEMA starters shall not be acceptable.

Table 1

NEMA Size Starter	Horsepower 480 V	Horsepower 208 V
1	Up to 7.5	Up to 5
2	20	7.5
3	40	20
4	75	36
5	100	--

C. Variable Frequency Drives

1. Description: NEMA ICS 2, pulse-width-modulated, variable frequency controller; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.
    a. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
2. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
3. Output Rating: 3-phase; 6-60 Hz, with voltage proportional to frequency throughout voltage range.
4. Unit Operating Requirements:
    a. Input ac voltage tolerance of 380-500 V, plus or minus 10%.
    b. Input frequency tolerance of 60 Hz, plus or minus 6%.
    c. Minimum Efficiency: 96% at 60 Hz, full load.
    d. Minimum Displacement Primary-Side Power Factor: 96%.
    e. Overload Capability: 1.1 times the base load current for 60 sec.; 2.0 times the base load current for 3 sec.
    f. Starting Torque: 100% of rated torque or as indicated.
    g. Speed Regulation: Plus or minus 1%.
    h. Ambient Temperature: 0-40°C.
5. Isolated control interface allows controller to follow control signal over an 11:1 speed range.
    a. Electrical Signal: 4-20 mA at 24 V.
6. Internal Adjustability Capabilities:
    a. Minimum Speed: 5-25% of maximum rpm.
    b. Maximum Speed: 80-100% of maximum rpm.
    c. Acceleration: 2 to a minimum of 22 sec.
    d. Deceleration: 2 to a minimum of 22 sec.
    e. Current Limit: 50 to a minimum of 110% of maximum rating.
7. Self-Protection and Reliability Features:
    a. Input transient protection by means of surge suppressors.
    b. Undervoltage and overvoltage trips; inverter over-temperature, overload, and overcurrent trips.
    c. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
    d. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
    e. Instantaneous line-to-line and line-to-ground overcurrent trips.
    f. Loss-of-phase protection.

g. Reverse-phase protection.

h. Short-circuit protection.

i. Motor over-temperature fault.

8. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration shall not damage controller, motor, or load.

9. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.

10. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

11. Integral Disconnecting Means: NEMA AB 1, molded-case switch with lockable handle.

12. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

13. Line Reactor: Unit shall have 5% Line Reactor and 5% dc Bus Choke, unless specified otherwise.

14. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allen Bradley.

b. Danfoss.

c. Square D

d. General Electric

e. Eaton.

f. WEG

D. Power Terminal Blocks

1. Power Wire Terminal Blocks (Motors, Solenoids, Valves, etc.):

a. Terminal blocks shall be NEMA Open System. Blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 600 V.

b. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits.

c. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed.

d. Wires shall be terminated to the terminal blocks with crimp type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated.

2. Terminal Tags, Covers and Markers:

a. Each terminal strip shall have a unique identifying alphanumeric code designation at one end and a plastic marking strip running the entire length with a unique number for each terminal.

b. Assign terminal strip numbers from the number "1" and continuing in ascending cardinal order. The terminal strip designation shall be the letters "TB" followed by the terminal strip number. The strip and terminal point designations shall be

machine printed and 1/8-inch high.

E. Phase Failure/Undervoltage Pump Protection

1. Where required in equipment specification, an independent power monitor shall be provided on the load side of the pump disconnects to monitor incoming voltage and provide protection to the motors. These power monitors shall detect incoming service abnormalities including phase-loss, unbalance, reversal, overvoltage, undervoltage and rapid cycling protection and provide automatic cutout of pumps and provide local alarm. Upon detection that incoming power has returned to normal, the unit will restore pump operation and discontinue alarm. This device shall have a nominal 2-4 sec. dropout delay and (2-300 sec.) adjustable restoration time delay.
2. The unit shall protect itself from voltage spikes and transients with internal transient protection meeting IEEE 587 standards.
3. The power monitor system shall also include a stagger time delay function providing time delay between lead and lag pump start to eliminate simultaneous starting of motors upon return of system power. This feature shall be operation in all modes of pump operation. The monitors will be SYMCON 460 VBM.

2.8 PANEL MOUNTED CONTROL OR INDICATING DEVICES

1. Combined Sounder and LED Beacon
   a. Where indicated panels shall be provided with a "Combined Sounder and LED Beacon". The combined sounder and flashing LED beacon shall have polycarbonate housing and lens, 45 mm size, 22 mm mounting hole, and Type 4X. Control logic shall be provided so that the unit can be silenced, until alarm is cleared and reset. The sounder shall have average dBA at 1 m of 103 and shall be configured as pulsing. The combined sounder and flashing LED beacon shall be as manufactured by Eaton, Model RoLP Maxi Solista; or equal.
2. Push Buttons, Selector Switches and Pilot Lights
   a. Push buttons, Type 4/4X/13 corrosion-resistant/watertight/oiltight plastic, selector switches and pilot lights shall be 30.5 mm type.
   b. Push buttons, selector switches and pilot lights shall have electrical ratings of:
      1) Dielectric strength: 2200 V for 1 min.
      2) Electrical design life cycles: 10,000,000 at maximum rated load
   c. Push buttons, selector switches and pilot lights shall have an operating range of minus 40-131°F (minus 40-55°C).
   d. Illuminated devices shall offer universal LED that accepts 12-130 Vac/Vdc voltage input. Lens color shall be as follows;
      1) Running, on, open: Red.
      2) Stopped, off, closed: Green.
      3) Alarm: Amber.
      4) White: Power on
      5) Blue: All other status indications not covered by the above
      6) Lens caps shall be approximately 0.46 inch diameter. Provide legend faceplates engraved to indicate the required function of each device; rated NEMA 4X.

e. Push buttons shall have a diaphragm seal for protection from liquids, particles and corrosive agents. Button colors shall be as follows;

1) Start, open: Red.

2) Stop, close: Green.

3) Black: All other status indications not covered by the above

f. Selector switches shall incorporate a positive detent to prevent the switch from hanging up between positions.

1) Selector switches shall incorporate a positive detent to prevent the switch from hanging up between positions.

3. Elapsed Time Meters

a. Meter shall be heavy duty, electro-mechanical, non-resettable, six digit 99999.9h Unit shall be NEMA 4X rated.

b. Mounting of unit with gasket shall maintain rating of enclosure.

4. Digital Panel Meter

a. Meter shall be electronic, 3.5 digit, 0.56-inch high efficiency LED display and shall provide indicated in engineering units of measured variable. Case type shall be watertight and dust tight (NEMA 4X).

2.9 INTERNAL CONTROL CIRCUIT DEVICES

A. Panel lighting

1. Panels shall be provided with a door switch activated 24 Vdc LED light.

B. Panel Service Receptacle

1. Panels, where indicated in equipment specifications. shall be provided with a DIN Rail Mounted straight blade, 125 V, 15 Amp, non-feed-through type receptacle. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include LED status indicator light.

C. Panel Incoming Surge Protection

1. Provide modular, pluggable surge protective device of the incoming power feed to the control panel. Units shall be metal oxide varistors (MOVs) and gas-filled surge arresters, with a maximum continuous operating voltage of 150 V.

D. Circuit Breakers

1. Breakers shall be thermal-magnetic, current-limiting type, UL Listed, 10 kA.

2. Housing shall satisfy Insulation Group II/RAL 7035, shall have IP20 finger-safe design, shall be suitable for DIN rail mounting and shall include status indicator window and scratch-resistant and solvent-resistant printing

E. 24VDC Power Supplies

1. Provide a 24 Vdc power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on-off circuit breaker. Size the 24 Vdc power supply to accommodate the design load plus a minimum 50% spare capacity. Power supply shall be primary switched, DIN Rail mounted, with LED indication and status contacts. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power

supply failure and to protect the power supply from damage due to external failure. Mount the 24 Vdc power supply such that dissipated heat does not adversely affect other panel components.

F. 120VAC Uninterruptible Power Supply (UPS)

1. Provide a 120 Vac UPS in the control panel to power control components, including PLC, relays, 24 Vdc power supplies, etc. as required. Equip the power supply with a power on/off circuit breaker. Size the UPS to accommodate the design load plus a minimum 50% spare capacity, with 10 min. battery life at full load. UPS shall be DIN Rail mounted, with LED indication and status contacts. Mount the UPS power supply such that dissipated heat does not adversely affect other panel components. Provide a maintenance bypass switch to allow the UPS to be taken out of service for maintenance or replacement.

G. Fuse Blocks

1. Fuse Blocks shall be DIN Rail mounted, single level, standard size, set screw terminal, with blown fuse indicator.

H. Terminal Blocks – 120Vac or 24Vdc

1. Terminal blocks shall be DIN-Rail mounted, IEC screw-type, feed-through, single level, rated IP20. Metal components shall be made of corrosion resistant materials. The metal body shall contain a serrated pressure plate that will provide a gas-tight connection with the conductor. Terminal Blocks shall have captive screws. Control terminal blocks shall have a snap-in card marking system. Marking shall be computer generated.

I. Relays

1. Relays – Time Delay
    a. Relays shall mount on tube-type bases with pin-style socket mounting. Shall have 10 Amp, B300, DPDT contact ratings and coil voltages as shown on drawings and adjustable timing ranges.
2. Relays – General Purpose
    a. Relays shall have tube-base/Octal 8-pin or 11-pin terminals and "ON-OFF" flag indicators. Contacts shall be silver nickel and have 10 Amp, B300, DPDT or 3PDT ratings. Shall have an electrical schematic on the faceplate, a clear cover for visual inspection and snap-in marker ability. Relays shall have LED status indicators, push-to-test and manual override.
3. Relays – Miniature
    a. Relays shall be square-base, 4-pole, plug-in type with blade-style terminals and "ON-OFF" flag indicators. Contacts shall be silver nickel and have 7 Amp or 10 Amp, DPDT or 4PDT ratings. Shall have an electrical schematic on the faceplate and a clear cover for visual inspection and LED status indicators and push-to-test button with incorporated manual override lever.
4. Relays - PLC Interposing
    a. Relays shall be DIN Rail Mount, screw terminal, slim factor design. Shall be pluggable, with ejector feature. Contacts shall be silver nickel and have 5 Amp, 24 Vdc or 3 Amp, 120 Vac, SPDT electro-mechanical and shall have LED status indicators.

5. Relays - Alternating

a. Alternator shall be provided to sequence motors where required for lead-lag operation. Alternator shall be Catalog No. 008-120-13SP or 009-120-23AP by Stacon; Square D, Class 9039, Type HG-21 or equal.

6. Timers – Solid-State

a. Timers shall be DIN rail mounted. Contacts shall be available as SPDT or DPDT, 8 Amp. Timers shall be available with On-Delay, Off-Delay, On-Delay and Off-Delay, One-Shot, and Flasher operating modes as required on the drawings. Timers shall have coil surge protection and adjustable timing ranges of 0.05 sec. to 60 hours as shown on drawings.

7. Timers – Programmable

a. Timers shall be digital timing relays with LCD display and shall be socket or panel mounted. Contacts shall be SPDT, rated 5 Amp, B300. Timers shall be configurable for Signal On-Delay, Power On-Delay, Off-Delay, Repeat Cycle, One-Shot, and Cumulative operating modes as required on the drawings. Timers shall have timing ranges of 0.000 sec. to 9999 hours, depending on selected mode and as shown on drawings.

J. Analog Signal Surge Protection

1. Analog signal surge protection shall be slim-factor hybrid design that combines solid-state electronic and gas filled discharge tube to provide protection to 20 kA.

K. Signal Isolators

1. Signal Isolators shall be DIN Rail mounted, solid state, ASIC technology; electronic type, with 0.15 accuracy. There shall be complete isolation between input circuitry, output circuitry, and the power supply. Zero and span adjustment shall be provided. Units shall be as manufactured by Action Instruments, Model Slim Pak; or approved equal.

L. Fiber Optic Patch Panel

1. Provide DIN rail mounted patch panels, as indicated in equipment specifications, to terminate cabling from the network elements. Physical locations and number of Type SC connectors supported shall be sufficient to terminate all fibers at each fiber drop point.

M. CAT 6 Patch Panel

1. Provide DIN rail mounted patch panels, as indicated in equipment specifications, to terminate cabling from the network elements. Performance parameters, including NEXT, Attenuation and Return Loss shall meet Category 6E Cabling Standard.

2.10 INTERNAL WIRING REQUIREMENTS

A. 120 Vac and 24 Vdc Wiring

1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 V insulation and be rated for not less than 90°C. Wiring for systems operating at voltages in excess of 120 Vac shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 Vac and lower voltage wiring systems without direct exposure

to higher voltages.

2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 14 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 V.
3. Power and low voltage dc wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60% visible fill.
4. Terminations
    a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable. Wiring for input/output (I/O) points for the PLC shall be allowed to terminate directly to interposing relay or surge protector.
    b. Multi-level terminal blocks or strips are not acceptable.
    c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, ac control, dc signal). Each group of terminal blocks shall have a minimum of 25% spares.
    d. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks. Wiring for I/O points for the PLC shall be allowed to terminate directly to interposing relay.
    e. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks. Wiring for I/O points for the PLC shall be allowed to terminate directly to surge protector.
    f. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
    g. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6 inches of the side panel or adjacent terminal or within 8 inches of the bottom of free-standing panels, or within 3 inches of stanchion mounted panels, or 3 inches of adjacent wireway.
    h. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
    i. Wire Tagging:
        1) Panel connection wiring shall be tagged at terminations with machine printed slip on type tags.

2) Provide wire-cable tag designations on all wiring diagrams submitted to the OWNER. Place tag within 2 inches of any wiring termination, affixing tag to prevent the tag from sliding more than 2 inches from the terminal as the result of gravity and vibration.

5. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.

6. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings. All power wiring, control wiring, grounding, and dc wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:

    1) Incoming 120 Vac Hot: Black
    2) 120 Vac Hot wiring downstream of panel circuit breaker: Red
    3) 120 Vac Hot wiring derived from a UPS system: Red with Black stripe
    4) 120 Vac neutral: White
    5) Ground: Green
    6) Dc power or control wiring: Blue
    7) Dc analog signal wiring: Black (+), White (-)
    8) Foreign voltage: Yellow

7. Each field instrument furnished as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. All instruments requiring 120 Vac power shall be powered from the UPS source in the panel where the instrument signals lands.

8. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

9. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

10. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

11. Field Entrance Internal Wiring:

    a. Field entrance internal wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (mV and mA) shall be bundle separately from the rest of the control wiring.

    b. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE.

    c. All conduit entering or leaving equipment shall be coordinated, in advance with the panel installer, so that the conduit entrances to the enclosure are directly below the termination area for immediate termination. Conduits shall not enter the top or side of the panel unless approved in writing by the OWNER and

ENGINEER.

12. Fusing of PLC Inputs and Outputs:
    a. All PLC analog inputs and outputs shall be individually fused for each channel.
    b. All discrete inputs and outputs shall be buffered with relays from the field connections. Discrete points shall be fused for each circuit group with no less than one fuse per PLC I/O card.
13. Buffering PLC Discrete Inputs and Outputs:
    a. All PLC discrete inputs and outputs shall be individually buffered with relays as specified. Where field voltage is ac reed type relays shall not be used.
14. Analog Input and Output Wiring:
    a. Provide a fuse for each analog signal. Each analog I/O and each spare analog I/O shall be furnished with a surge protection device hardwired to the fed-through terminal block.

2.11 PROGRAMMABLE LOGIC CONTROLLER (CHASSIS MOUNTED)

A. General
1. Provide Programmable Logic Controller equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
2. Processor Systems shall include processor, power supply, I/O modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.
3. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory and resume normal operation without manually resetting when power is restored.
4. The PLC shall be capable of stand-alone operation in the event of failure of the communication link to the Plant Control System.
5. Backup Remote Input/Output Units shall include input/output modules, interface modules, communication modules, and power supply to meet system input and output requirements.
6. Agency and environmental specifications:
    a. Electrical supply voltage to the PLC shall be 120 Vac, plus or minus 15%, 48-63 Hz. PLC system power supplies shall be fused for overload protection.
    b. All products shall have corrosion protection.
7. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.

B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Allen-Bradley, Compact Logix
2. General Electric, RX3i
3. Modicon, M340

C. Programming Languages

1. Each PLC shall support IEC Standard 61131-3 for all of the following programming languages:
2. Ladder (LD)
3. Function Block Diagram (FBD)
4. Structured Text (ST)
5. PLC shall support user defined functions for customization and user defined tag structures.
6. PLC shall have application-specific instructions for process, drive, batch, motion, and safety applications built into the controller.

D. Central Processor Unit (CPU)

1. Each processor shall have the maximum IEC Program Memory size available at time of procurement.
2. Provide hardware employing identical revisions of software and firmware as applicable.
3. Processor shall have a minimum IEC program memory size of 1024 kB.
4. The CPU shall contain a minimum of 1 serial configuration port and 2 Ethernet ports.
5. The CPU shall be able to do time synchronization for the system.

E. Physical Construction (Chassis)

1. The PLC shall be of the modular construction, consisting of a back plane, plug in modules for the processor, communication modules, I/O modules and expansion modules.

F. Power Supply (PS)

1. The power supply shall be 120 V, 60 Hz, and shall be sized for the total quantity of modules including the power requirement of spare I/O module slots.

G. I/O Modules: The following types of process I/O interface capabilities shall be provided for the PLC:

1. Discrete Input Requirements:
    a. Responsible for the PLC interface with the status and alarm contacts.
        1) For the "dry" contacts: PLC shall sense the states of these contacts by applying a voltage and observing the extent to which current flows.
        2) This voltage shall be obtained from a separate, isolated power supply furnished by the CONTRACTOR
        3) Voltage applied across the open contacts shall be 24 Vdc (nominal), or 110 Vac.
    b. Exact input configuration sized to meet the existing discrete input needs as specified on the Drawings.
    c. Final configuration based on the standard product offering of the PLC manufacturer.
    d. Discrete inputs shall be 24 Vdc and be individually buffered with external relays.
    e. Number of Points per Card: 16

2. Discrete Output Requirements:
    a. Discrete output logic shall process the control commands received from the common logic. Control schemes, in which a single message with undetected errors can cause a false command, shall be unacceptable.
    b. Discrete output drive circuitry shall be designed such that any single logic component failure in the PLC does not energize a discrete output.
    c. Exact output configuration sized to meet existing discrete output needs as specified on the Drawings.
    d. Final configuration based on the standard product offering of the PLC manufacturer.
    e. Discrete outputs shall be of the relay type and individually buffered with external relays.
    f. Number of Points per Card: 16
3. Analog Output Requirements:
    a. Provide analog output modules having a 4-20 mA at 24 Vdc; suitable for interfacing to an electronic three mode controller or direct to a variable frequency drive.
    b. Analog outputs are driven from the isolated 24 Vdc power supply supplied in the PLC Panel. The module shall have broken wire fault detection.
    c. Exact output configuration sized to meet analog output needs as specified on the Drawings.
    d. Final configuration based on the standard product offering of the PLC manufacturer.
    e. Number of Points per Card: 8
4. Analog Input Requirements:
    a. Analog inputs from the transducers shall be 4-20 mA dc and all transducer power shall be provided by the dedicated 24 Vdc plus 10% power supply supplied in the PLC Panel, or from an isolated output of the field device. The module shall be Bi-Polar with broken wire and Out of Range fault detection.
    b. Exact input configuration sized to meet the analog input needs as specified on the Drawings.
    c. Final configuration based on the standard product offering of the PLC manufacturer.
    d. Number of Points per Card: 8

H. PLC Power Supply: PLC power supplies shall be supplied with 110 Vac. PLC power supplies shall contain a “POWER OK” LED.

2.12 OPERATOR INTERFACE TERMINALS (OIT)

A. OITs shall be mounted on control panels, where shown on drawings.

B. Manufacturers
1. Provide operator interface terminals (OIT) from one of the following:
    a. Allen-Bradley PanelView Plus 6 series

b. GE Loaded QuickPanel View series

c. Pro-face AGP3000/ AST3000 series

d. Siemens SIMATIC HMI IPC series

C. Software

1. The Operator Interface Terminal shall be pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.
2. The integrated OIT software shall have the following features
   a. Trending
   b. Data Logging
   c. Alarms
   d. Graphic Symbols
   e. Animations

D. I/O Ports and Devices

1. The OIT shall have a minimum of one Ethernet 10/100 Mbps for connectivity or programming.
2. The OIT shall have a minimum of one Serial RS 232 port.
3. Compact flash ports shall be Type 2.
4. The OIT shall have a minimum of one USB port.

E. Display

1. The OIT display size shall be a minimum of 6 inches for wall mounted panels and 12 inches for floor mounted panels
2. The type of display for the OIT shall be Color Active Matrix TFT.
3. Display shall support touch screen input.

F. Environmental

1. Rating: OIT shall be rated to maintain the rating of the control panel it will be mounted in.
2. Temperature: Operating temperature range of the OIT shall range 0-50°C.

G. Operator screen shall be provided with a hinged screen to protect screen of sun light. Sun shield shall be Shade Aide by Smith and Loveless, Inc.

2.13 PROGRAMMING CABLES

A. Provide two programming cables for each type of PLC to be programmed.

2.14 MEMORY MAPS REQUIREMENTS

A. The control panel vendors shall comply with the following;

1. Submit memory map of PLC registers to be transmitted to SCADA as part of their submittal.
2. All vendors supplying control panels that communicate with the plant SCADA network shall submit a memory map of PLC registers to the Control System Integrator no later than 30 days prior to the scheduled shipment of the vendor equipment to the site.

Vendor shall contact and coordinate with the Control System Integrator to ensure compatible configuration of the vendor PLCs in order to match the facility network. Vendor shall configure the network addresses in their equipment to match the addresses determined by the Control System Integrator. Software communication shall be provided in contiguous registers. One set of registers shall be provided for writing discrete-type information, and one set shall be provided for reading discrete-type information. One set of registers shall be provided for writing floating-point information, and one set shall be provided for reading floating-point information.

2.15 INDUSTRIAL ETHERNET PROTOCOL CONVERTER

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Digi
      a. Model: Digi One IA Industrial Serial Server
   2. B&B Electronics
      a. Model: MESR900 Series Industrial Modbus Ethernet to Serial Gateways

B. Environmental
   1. Operating temperature: 32-140°F
   2. Operating humidity: 10–90% Non-condensing
   3. Storage Temperature: 32-140°F

C. Physical
   1. Power Supply: 24 Vdc
   2. Microprocessor based managed type.
   3. DIN Rail mountable.
   4. Class 1 Division 2 rated

D. Functional Performance
   1. Per Port status LED indication.
   2. Wire Speed switching.
   3. 10/100 BaseT ports with RJ-45 connectors for Category 6 cabling.
   4. ST or SC type Fiber Optic Connectors for 100BaseFX, 1000BaseSX for Multimode Fiber and 1000BaseLX for Single Mode Fiber as shown on the drawings.
   5. RS 232 Ports with terminals. Selectable link termination (100 ~120 Ω)

E. Options and Accessories Required:
   1. Provide minimum 3-year warranty.
   2. The protocol interface shall implement the following:
      a. All data shall be available and/or mirrored within the Modbus 4x or "Holding Register" memory area.
      b. Register 4x00001 shall exist and be readable-writable to allow simple, predictable "communication tests".
   3. The media protocol converter shall meet the following criteria:
      a. The converter shall support 10/100Base-T Ethernet. The serial port speed (baud

rate) shall support 230 kBd. The protocol shall support Ethernet IP, Modbus TCP and Modbus RTU/ASCII. Protocol shall be Web Browser configurable.

2.16 INDUSTRIAL ETHERNET MEDIA CONVERTER

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Beldon
   2. B & B Electronics
   3. Moxa
   4. N-TRON
   5. SIXNET

B. Environmental
   1. Operating temperature: 32-104°F
   2. Operating humidity: 20–95% Non-condensing
   3. Storage Temperature: minus 40-158°F

C. Physical
   1. Power Supply: 24 Vdc
   2. Microprocessor based managed type.
   3. DIN Rail mountable.

D. Functional Performance
   1. Per Port status LED indication.
   2. Wire Speed switching.
   3. 10/100BaseT ports with RJ-45 connectors for Category 6 cabling.
   4. ST or SC type Fiber Optic Connectors for 100BaseFX, 1000BaseSX for Multimode Fiber and 1000BaseLX for Single Mode Fiber as shown on the drawings.

2.17 MISCELLANEOUS

A. Face-mounted equipment shall be flush or semi-flush, with flat black escutcheons. Cutouts for future equipment and holes resulted from removal of existing devices shall be blanked off with suitable covers as required to retain the cabinet's NEMA rating. Component identification shall be hot ink stamped on the panel interior.

B. Hardware and Fittings: All miscellaneous hardware and fittings shall be Type 316 stainless steel.

C. The bottom 12 inches of free-standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing. If top fed, the top 12 inches of free-standing panels shall be free of all devices.

2.18 FACTORY TESTING - GENERAL

A. The entire control panel shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer’s routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.

B. The operational test shall include the proper connection of supply and control voltage and, as far as practical, a mockup of simulated control signals and control devices shall be fed into the boards to check for proper operation.

C. Factory test equipment and test methods shall conform to the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards, and shall be subject to the OWNER and ENGINEER's approval.

2.19 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Spare part requirements shall be as indicted in the table below.

Description	Percent of Each Type and Size Used	No Less Than
Dc power supplies	20	2
Fuses	20	10
Relays and bases	20	10
Analog surge protectors	20	3
Power line surge protectors	20	2

PART 3 - EXECUTION

3.1 INSTALLER'S QUALIFICATIONS

A. Installer shall be specialized in installing this type of equipment with minimum 5 years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.2 EXAMINATION

A. Examine installation area to assure there is enough clearance to install the equipment.

B. Housekeeping pads shall be included for the floor mounted panels as detailed on the drawings.

C. Check concrete pads and baseplates for uniformity and level surface.

D. Verify that the equipment is ready to install.

E. Verify field measurements are as instructed by manufacturer.

3.3 INSTALLATION

A. The CONTRACTOR shall install all equipment per the manufacturer's recommendations and contract drawings.

B. Conduit hubs for use on raceway system pull and junction boxes shall be watertight, threaded aluminum, insulated throat, stainless steel grounding screw.

C. Install required safety labels.

3.4 RACEWAY SEALING

A. Where raceways enter control panels containing electrical or instrumentation equipment, all entrances shall be sealed with 3M 1000NS Watertight Sealant.

B. This requirement shall be strictly adhered to for all raceways in the conduit system.

3.5 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

C. Provide laminated copies of the control schematics along with the final approved I/O list in each enclosure door pocket.

3.6 CLEANING

A. Remove all rubbish and debris from inside and around the panel. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.7 EQUIPMENT PROTECTION AND RESTORATION

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.8 TESTING, COMMISSIONING AND TRAINING

A. Testing and Commissioning: Accomplished in accordance with the requirements of Section 01 70 00 - Execution and Closeout Requirements.

B. Training: Accomplished in accordance with the requirements of Section 01 70 00 - Execution and Closeout Requirements.

END OF SECTION

SECTION 40 05 93
COMMON MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors, 250 HP and smaller, for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. Related Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.

1.2 REFERENCES

A. Motors shall be designed, built, and tested in accordance with the latest revision of the following standards:

1. National Electrical Manufacturers Association Inc. (NEMA)
    a. NEMA MG1 - Motors and Generators.
    b. NEMA MG2 - Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.
    c. NEMA MG3 - Sound Level Prediction for Installed Rotating Electrical Machines.
2. National Fire Protection Association (NFPA)
    a. NFPA-70 - National Electrical Code.
3. Underwriters Laboratories, Inc. (UL)
    a. UL-1004 - Electric Motors.
4. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
    a. IEEE Std 1 - General Principles for Temperature Limits in the Rating of Electric Equipment.
    b. IEEE Std 43 - Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
    c. IEEE Std 85 - Test Procedures for Airborne Sound Measurements on Rotating Electric Machinery.
    d. IEEE Std 112 – Standard Test Procedure for Polyphase Induction Motors and Generators.
    e. IEEE Std 275 - Recommended Practice for Thermal Evaluation of Insulation Systems for AC Electric Machinery Employing Form-wound Pre-insulated Stator Coils, Machines Rated 6,900 V and Below.
    f. IEEE Std 429 - Standard Test Procedure for the Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form-wound Stator Coils.
    g. IEEE Std 1349 – Guide for the Application of Electric Motors in Class 1, Div 2 Hazardous Locations.
5. Anti-Friction Bearing Manufacturer's Association Inc. (AFBMA):

a. AFBMA-9 & 11 - Load Ratings and Fatigue Life for Roller Bearings.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   a. Motor controllers.
   b. Torque, speed, and horsepower requirements of the load.
   c. Ratings and characteristics of supply circuit and required control sequence.
   d. Ambient and environmental conditions of installation location.
2. Unit Responsibility: Motors shall be furnished under other sections as a part of the driven equipment. The CONTRACTOR is responsible for all coordination between the various components, as well as the confirmation and coordination of the warranty.

1.4 SUBMITTALS

A. Shop Drawings: Include the following:

1. Manufacturer.
2. Rated full load horsepower.
3. Rated volts.
4. Number of phases.
5. Frequency in hertz.
6. Locked rotor amperes (LRA) at rated voltage or NEMA code letter.
7. NEMA design letter.
8. Bearing Type.
9. Service Factor.
10. Nominal speed at full load.
11. Full Load Amperes (FLA)
12. Efficiency at 1/2, 3/4 and full load.
13. Power factor at no load,1/2, 3/4 and full load.
14. NEMA insulation system classification. For motors required to install outdoors, include information showing compliance with the intent of paragraph 1.4.B.

B. Integral Horsepower Motors 40HP and Larger: In addition to the information listed above, include:

1. No load amperes.
2. Safe stall time.
3. Motor manufacturer's recommended maximum power factor correction capacitor kva that can safely be switched with the motor.
4. Expected value of corrected power factor at no load, 1/2, 3/4 and full load.
5. Maximum guaranteed slip at full load.
6. Motor damaged curves for motors larger than 100 HP.

C. Include the motor data sheet at the end of this section in submittal.

1.5 QUALITY ASSURANCE

A. Motor Compatibility. The Motor manufacturer and driven equipment manufacturer shall guarantee that the motor included with the driven equipment is compatible with driven equipment and complies with these Specifications. In the event that the motors described in these Specifications cannot be applied to the application or equipment offered, the Contractor may submit an exception, stating clearly the deviations and the reasons for such deviations. The acceptance or rejection of such deviations shall be at the sole discretion of the Owner/Engineer.

B. When motors are furnished with driven equipment, the driven equipment supplier shall be responsible for mounting the motor and driven equipment as a complete unit, correctly aligned and coupled with the coupling or sheave specified on the driven equipment data sheet, and for designing vibration, special, or unbalanced forces resulting from equipment operation.

C. Motors manufactured more than twenty four (24) months prior to the date of this Contract will not be acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment during shipment, handling, and storage by suitable complete enclosures. Protect equipment from exposure to the elements and keep thoroughly dry.

B. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repaint damaged painted surfaces to the satisfaction of the Owner/Engineer.

C. Equipment shall not be stored onsite without written approval of the Owner/Engineer. Equipment must be installed in its permanent location shown on the Drawings within seven (7) calendar days of arriving onsite. If the equipment cannot be installed within seven (7) calendar days, the equipment shall not be delivered to the site, but stored offsite, in an air conditioned, bonded, warehouse of the Contractor's choice and at the Contractor's expense, until such time that the site is ready for permanent installation of the equipment.

D. Where space heaters are provided in motors, provide temporary electrical power and operate space heaters, during jobsite storage and after motors are installed in permanent location, until equipment is placed in service.

E. The motor shaft shall be rotated on a monthly basis, if such is recommended or required by the motor manufacturer, the date recorded, and copies of the record provided to the Owner/Engineer and the manufacturer. The manufacturer shall confirm receipt of the rotation record.

1.7 SITE CONDITIONS - NOT USED

1.8 WARRANTY

A. Extended Equipment Warranty: Refer to Section 01 78 36 - Warranties for extended equipment warranty.

B. All equipment furnished under this section shall have a special equipment warranty, in accordance with the Contract Documents, for a period of two (2) years after the date of Substantial Completion. The cost of removal, shipment, repair, and installation by CONTRACTOR shall be included in the warranty and correction of defective work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements of this Section, provide products by one of the following:
   1. General Electric: “Severe-Duty”
   2. Westinghouse: “Mill and Chemical”
   3. Reliance: “Duty Marker”
   4. Baldor: “Chemical Duty”
   5. Siemens: “Severe-Duty”
   6. WEG: “Severe-Duty”

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules, Drawings, or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE P841for severe-duty motors.

2.3 RATING

A. Speed and Size:
   1. Speed and horsepower sizes are specified in the driven equipment specification sections or are indicated on the Drawings.
   2. Furnish motors sufficiently sized for the particular application and with full-load rating not less than required by the driven equipment at specified capacity.
   3. Size motors so as not to overload at any point throughout the normal operating range.

B. Voltage:
   1. Fractional Horsepower through 1/2 horsepower, single phase: 120 volts.
   2. Larger than 1/2 horsepower, three phase - 480 volts, unless otherwise indicated in the drive equipment specification sections or as indicated on the Drawings.

2.4 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.5 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium Efficiency, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings:

1. Motors Smaller than 1/6 Horsepower: Motor manufacturer's standard bearing is acceptable.

2. Motors 1/6 Horsepower and Larger: Supply these motors with grease-lubricated antifriction ball bearings conservatively rated for 100,000 hours of continuous operation under the total radial and thrust loads produced by the actual combination of motor-driven equipment. Provide each motor with suitable lubrication fittings and pressure relief devices.

3. Oil Lubricated: If the driven equipment section specified oil-lubricated bearings for motors, include a suitable sight gauge on each bearing with maximum and minimum levels clearly indicated.

G. Temperature Rise: Class B.

H. Insulation: Class F insulation with temperature rise of a Class B system or better, meeting the requirements of NEMA MG 1 and made of non-hygroscopic materials. The insulation shall be manufacturer’s premium grade, resistant to attack by moisture, acids, alkalis, and mechanical or thermal shock for 480 volt motors. All insulated winding conductors shall be copper.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material:

1. Use enclosure type as follows:

a. Indoors: Totally enclosed, fan cooled (TEFC).

b. Outdoors: Totally enclosed, fan cooled (TEFC), weatherproof.

c. Division 1, Class 2 Areas: Provide motors totally enclosed, fan cooled, explosion proof (TEFC-XP).

2. TEFC motors shall have a steel or cast iron frame, cast iron end brackets, cast iron conduit box, tapped drain holes (erosion resistant plug for frames 286T and smaller and automatic breaker/drain devices for frame 324T and larger), and upgraded insulation by additional dips and baked to increase moisture resistance.

2.6 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Shall include an insulated bearing opposite the drive end and shall include shaft grounding as manufactured by AEGIS.

C. Severe-Duty Motors: Comply with IEEE P841, with 1.15 minimum service factor.

2.7 NAMEPLATES

A. Main Nameplate: Provide each motor with a stainless steel name-plate meeting the requirements of NEMA MG 1, and the National Electrical Code.

B. Heater Nameplate: When space heaters are furnished, include voltage and wattage on a suitable nameplate.

C. Bearings Nameplate: When bearings are oil lubricated, include oil type information on a suitable nameplate. Also, indicate bearing data if nonstandard.

D. Attachment: Attach the nameplates to the motor with stainless steel fastening pins or screws.

2.8 CONDUIT BOX

A. Provide each motor not supplied with a cord and plug with a conduit box amply dimensioned for the motor lead terminations. Include a grounding lug on motors 1/6 horsepower and larger. Supply a gasket suitable for the motor enclosure type and application.

2.9 SPACE HEATERS

A. Provide space heaters in all motors.

B. Use heaters hermetically sealed in stainless steel or equivalent corrosion-resistant sheaths.

C. Rate heaters 115 volts, 60 hertz.

D. Braze heat-resistant insulated leads to the heater or supply heater with brazed leads and extend to the conduit box.

E. Size heaters according to the horsepower size as follows:
1. 3/4 - 50 horsepower – 100 watts
2. 60-125 horsepower – 150 watts
3. 150-200 horsepower – 200 watts

2.10 MONITORING DEVICES

A. All motors 20 HP and above and motors driven by variable frequency drives shall be equipped with three (3) normally open PTC thermistors, wired in parallel.

2.11 GROUNDING CONNECTIONS

A. Ground provisions shall be furnished per NEMA M91.

B. For motors less than 10HP, each motor shall be furnished with provision for attaching a ground connection to the motor frame inside the motor terminal housing.

2.12 LEADS

A. For motor leads, use not less than ASTM B 173, Class G, stranded copper conductors with insulation the same as or better than specified in the preceding Motor Insulation paragraph.

B. Provide permanent identification numbers on leads according to NEMA MG 1-2.02.

C. Use crimp-on, solderless tinned copper terminals on leads and place heat-shrink insulation sleeves or covers between leads and terminals.

2.13 ADDITIONAL REQUIREMENTS FOR VERTICAL MOTORS

A. Solid shaft vertical motors are acceptable for all applications except when the connection to the driven equipment consists of sectional driven shaft which may unscrew and lengthen with direction reversal.

B. Hollow-shaft vertical motors are acceptable for all applications when the thrust is in the direction to engage the coupling.

C. Hollow-shaft vertical motors coupled to a sectional drive shaft with screwed joints shall have special couplings described as follows:

1. Provide motors, except the explosion-proof type, with self-releasing couplings designed to disconnect motor from driven equipment and permit lengthening of drive shaft upon reversal of rotation.
2. Provide explosion-proof motors with non-reversing couplings of spark-resisting construction, designed to prevent reverse rotation.

D. Design vertical motor thrust bearings conservatively to carry maximum axial thrusts (up and down) imposed by driven equipment.

E. Vertical motors shall have grease or oil-lubricated bearings at both top and bottom.

F. Vertical motor bases shall be NEMA Type P.

G. Provide hollow shaft vertical motors with a positive, non-reversing, corrosion-resistant (anti-ratchet) mechanism.

H. Provide vertical motors with fan-end splash shields.

2.14 POWER FACTOR CORRECTION CAPACITORS

A. Linear Loads

1. All single speed motors over 5 horsepower (from variable frequency drives), if indicated on the Drawings, shall be provided with a heavy duty industrial type power factor correction capacitor selected, recommended and furnished by the motor manufacturer to raise the motor power factor to approximately 95 percent. For non-explosion-proof motors, the capacitor shall be mounted on the equipment base plate adjacent to the motor and shall be connected to the motor junction box with liquid tight flexible conduit. For explosion-proof motors, the capacitors shall be wall mounted in a non-hazardous area.
2. Capacitors shall be dry film or liquid insulated and shall be hermetically sealed in steel enclosures.
3. Each capacitor unit shall be furnished with three high interrupting capacity current limiting fuses. Fuses shall be equipped with "blown-fuse" indicators.
4. Capacitor enclosures shall be suitable for conduit connection. Covers shall be gasketed, bolt-on type.

5. Capacitors shall be UL listed.
6. Capacitors shall be by General Electric Co.; Square D Co. or equal.

B. Alternate Power Factor Correction Equipment (Non-Linear Loads)
1. Units shall be designed to provide power factor correction in applications subject to the effects of harmonics.
2. Units shall consist of power factor correction capacitors equipped with series inductors. The units shall be tuned to just below the 5th harmonic frequency on systems with predominately 3 Phase loads.
3. Capacitors shall be NEMA rated and tested, shall be non-PCB dielectric, biodegradable, low toxicity, equipped with current limiting fuses, internal discharge resistors and fuse loss indicators. Fuses shall be capable of interrupting a short circuit of 100,000 Amps at 480 Volts, 3 Phase.

C. Inductors shall have low flux density and distributed gaps, copper windings, brazed connections, winding varnish impregnated and baked, Class 220°C insulation with 80°C rise.

2.15 SINGLE-PHASE MOTOR

A. Motors 1/6 through 1/2 Horsepower: Provide single-phase NEMA Design N, squirrel cage induction motors

B. Motors Smaller than 1/6 Horsepower: Provide single-phase squirrel cage induction motors with integral thermal protectors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall make all electrical connections to equipment specified. Installation shall be made in compliance with manufacturer's recommendations and the Drawings. If the Drawings or shop drawings and recommendations from the Manufacturer are not available then installation shall proceed according to the best electrical industry and trade practice.

B. Properly install and align motors in the locations shown, except motors which are factory mounted on the driven equipment. When the motor and equipment are installed, the name- plate must be in full view.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports.

3.2 PERFORM THE FOLLOWING FIELD TESTS AND INSPECTIONS AND PREPARE TEST REPORTS

A. Perform each electrical test and visual and mechanical inspection, stated in NETA ATS “Rotating Machinery, AC Induction Motors and Generators” Certify compliance with test parameters.

3.3 MOTOR DATA SHEET

A. The Motor Data Sheet included after END OF SECTION shall be part of this section.

END OF SECTION

ELECTRICAL MOTOR DATA SHEET

Manufacturer: _____ Model: _____ HP: _____

Motor Service: _____ Starting Conditions:_____

Frame: _____ Enclosure: _____

Voltage: _____ Phases:_____ RPM:_____ Hertz:_____

Insulation Class:_____ Duty:_____

Full Load AMPS: _____ No. Load AMPS:_____

Locked Rotor AMPS: _____ Locked Rotor Time:_____

Locked Rotor Torque: _____ % Breakdown Torque:_____%

NEMA Design: _____ Service Factor: _____

Number of Consecutive Starts: _____ Hot: _____ Cold:_____

Full Load Temp Rise, degrees C over 40 degrees C Ambient

(at 1.0 S.F.):_____

Service Factor Temp Rise, degrees C over 40 degrees C

(at 1.15 S.F.):_____

Drive System: _____V-Belt _____Direct Coupled _____Gear Unit

Bearings: Type:_____ Life:_____ Lubrication:_____ Shaft: Size_____

	Efficiency:	Power Factor:	Current:
1.15 S.F. Load:	_____	_____	_____
4/4 Load:	_____	_____	_____
3/4 Load:	_____	_____	_____
1/2 Load:	_____	_____	_____

Monitoring Devices: _____ RTD's _____ Vibration Sensors _____Thermistors

Main Motor Leads, size hole_____ Space Heater: _____KW

Ground Lug Size_____ Surge Protection: _____

Blank spaces are to be completed by manufacturer.

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SECTION 46 43 61
FLOCCULATING CLARIFIER UNIT

PART 1 - GENERAL

1.1 SUMMARY

A. Up to two (2) 75’-0” diameter circular flocculating clarifier mechanisms.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Bearing Manufacturers Association (ABMA):
      a. 9, Load Ratings and Fatigue Life for Ball Bearings.
      b. 11, Load Ratings and Fatigue Life for Roller Bearings.
   2. American Gear Manufacturers Association (AGMA):
      a. 2001, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
      b. 2004, Gear Materials, Heat Treatment and Processing Manual.
      c. 6022, Design Manual for Cylindrical Wormgearing.
      d. 6034, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
      e. 9005, Industrial Gear Lubrication.
   3. American Institute of Steel Construction (AISC).
   4. American Society of Mechanical Engineers (ASME): B29.100, Precision Power Transmission, Double-Pitch Power Transmission, and Double-Pitch Conveyor Roller Chains, Attachments, and Sprockets.
   5. American Welding Society (AWS):
      a. D1.1/D1.1M, Structural Welding Code – Steel.
      b. QC 1, Standard for AWS Certification of Welding Inspectors.
   6. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A48/A48M, Standard Specification for Gray Iron Castings.
      c. A148/A148M, Standard Specification for Steel Castings, High Strength, for Structural Purposes.
      d. A536, Standard Specification for Ductile Iron Castings.
   7. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
      b. MG 1, Motors and Generators.
   8. The Society for Protective Coatings (SSPC): SP 7, Brush-off Blast Cleaning.
   9. Underwriters Laboratories (UL): 674, Standard for Safety Electric Motors and Generators for Use in Hazardous (Classified) Locations.

1.3 DEFINITIONS

A. Alarm Torque: 90 percent of Design Running Torque.

B. Certified Welding Inspector (CWI): As defined in AWS QC 1.

C. Cutout Torque: 120 percent of Design Running Torque.

D. Design Running Torque:

1. Torque used to select size, strength, and type of materials and components for mechanism and drive system.
2. At which or below will provide continuous 24-hour per day operation for period of not less than 20 years at design torque condition and rotational speed without damage, permanent deformation or overload.
3. Equal to 50 percent on overload device scale.
4. Applied at the output of the low speed final reduction unit.

E. Slenderness Ratio: Ratio of unbraced length to least radius of gyration.

F. Submerged Metal: Metal below the gear head drive.

G. Ultimate Torque:
1. 200 percent of Design Running Torque and below which no portion of mechanism will be damaged if operated for only a short period of time (a few seconds) and equal to 100 percent on overload device scale.
2. Applied at the output of the low speed final reduction unit.

1.4 SUBMITTALS

A. Action Submittals:
1. Shop Drawings:
a. Product Data:
1) Equipment Assembly: Make, model, weight, and horsepower.
2) Product information, descriptive literature, dimensional layouts, specifications, standard and specialized equipment assembly cuts, and identification of materials of construction.
3) Painting/Coating System(s): Manufacturer's descriptive technical catalogue literature and specifications.
b. Anchorage and bracing data sheets and drawings.
c. Detailed Drawings:
1) Structural, Mechanical, and Electrical: Show equipment fabrications and interface with other items including dimensions, thicknesses, size, and locations of connections to other work, and weights of associated equipment.
2) Structural and Mechanical: Details of center torque cage, center pier and influent pipe, walkway bridge and center platform, influent well, and rotating rake arm trusswork.
d. Design Details:
1) Rake tip speed, rotation direction, and sludge loading capacity.
2) Hydraulic loading rates.
3) Running, alarm, cutout, and ultimate torque ratings of drive unit assembly.
4) Ultimate torque load capabilities of drive unit assembly, torque cage, and rotating rake arm trusswork.
5) Velocity gradient calculations.
e. Certification of Structural Calculations: Letter of certification for structural design of mechanism, signed and sealed by Professional Engineer registered in the State of Oklahoma. Copies of detailed structural design calculations shall not be submitted for review. If submitted, calculations will be returned without review.

f. Structural Loads: Static, dynamic, and torque reaction loads to be transferred into structure at center column and access bridge support locations.
g. Details of torque sensing and load indication device.
h. Identification of outside utility requirements for each component such as air, water, and power.
i. Control panel elevation drawings showing placement of operator interface devices and other elements.
j. Motor drawings, electrical drawings, power and control wiring diagrams, including terminals and numbers.
k. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.
l. Diameter of ball race.
m. Any other information necessary for the Engineer to review for compliance with the Specifications.
n. All calculations shall be signed and sealed by a Professional Engineer registered in the State of Oklahoma.

B. Informational Submittals:
1. Designer qualifications.
2. Anchorage and bracing calculations.
3. Manufacturer's Certificate of Compliance.
4. Special shipping, storage and protection, and handling instructions.
5. Manufacturer's shop and field test procedures, and other procedures as required by the specifications.
6. Manufacturer's shop and field test results, reports, and certifications, and other results, reports and certifications as required by the specifications.
7. Welder/welding operator qualifications.
8. Welding inspector credentials.
9. Welding Inspector's Report.
10. Location of nearest stocking distributor of spare parts.
11. Operation and Maintenance Data.
12. Manufacturer's installation report.
13. Manufacturer's Certificate of Proper Installation.
14. Service records for maintenance and conditioning performed through Substantial Completion.
15. Warranties and service agreements, in accordance with Division 1 Section 01 60 00 "Product Requirements."
16. Reference list as required by the Special Conditions.

1.5 QUALITY ASSURANCE

A. QUALIFICATIONS
1. Designer: Registered Professional Engineer in the State of Oklahoma, who has performed structural design of at least 10 (ten) circular clarifier mechanisms of size equal to or greater than 60 feet in diameter.
2. Experience: All equipment shall be the product of a manufacturer having at least 20 U.S. installations of the type being proposed, each with a minimum of 5 years of satisfactory service.

3. The equipment is intended to be standard equipment of proven ability as manufactured by a single manufacturer who is fully experienced, reputable, and qualified in manufacture of the equipment to be furnished.
4. The equipment shall be manufactured, fabricated, and installed in accordance with the best practices and methods and to operate satisfactorily when installed as shown on the drawings.
5. All surfaces and material in contact with water, or in contact with chemical being added to water that is being treated for potable use shall conform to ANSI/NSF Standard 61 and be certified by an organization accredited by ANSI.
6. Spare Parts: Manufacturer shall maintain a complete stock of spare parts commonly needed for the equipment specified at a location within the State of Oklahoma or shall furnish spare parts within 48 hours of request.
7. Welder/Welding Operator: In accordance with AWS D1.1/D1.1M.
8. Welding Inspector: Certified in accordance with AWS QC 1 and having prior experience with welding codes specified.

1.6 EXTRA MATERIALS

A. Manufacturer shall furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Gaskets, O-rings, keys, dowels, and pins	One complete set per unit
Drive chain and belts (if used)	One set each type and size per unit
Sight glasses and oil gauges (if used)	One set of each type and size per unit
Special tools required to maintain or dismantle drive unit except for low speed main bearing, but including that required for removal/insertion of main bearing race balls	One complete set
Other Items	As recommended by the manufacturer

B. Contractor shall furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Lubricants, Food Grade (per Manufacturer's recommendation)	As required for 1 year of continuous operation per unit; locally obtained and provided per manufacturer's listing of approved lubricants

C. Delivery: In accordance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
1. Eimco Water Technologies (EWT), Ovivo.

2. Envirex, Evoqua Water Technologies.
3. Walker Process Equipment, Division of McNish Corporation.
4. WesTech Engineering.

B. No “or-equal” or substitute products will be considered.

2.2 SERVICE CONDITIONS

A. Material Handled: Polymer, sodium hydroxide, and copper sulfate combined with raw water turbidity sludge produced by a coagulation, flocculation, and sedimentation process.

B. Influent Liquid Temperature Range: 35 degrees F, minimum to 95 degrees F, maximum.

C. Site Conditions:
1. Design for the following Site conditions:
a. Exposure: Direct Sunlight.
b. Ambient Temperature Range: Minimum -5 degrees F to 120 degrees F, maximum.
c. Ambient Humidity Range: Minimum 10 percent to 100 percent relative humidity.
d. Altitude: 1,200 feet above sea level

2.3 MANUFACTURED UNITS

A. Provide up to two (2) flocculating clarifier units meeting performance and design requirements as specified below.

B. General:
1. The flocculating clarifier unit shall be designed to flocculate, settle, and collect solids that have previously been subjected to a rapid mix process and rake them to the mechanism center for removal.
2. Suitable for installation in an existing basin with a 75-foot diameter, 15-foot sidewall water depth (SWD), 1.5-foot freeboard, and floor slope of 1 inch per foot from the tank wall to the 30’ diameter recessed floor. Floor slope is 2 inches per foot in the recessed floor. Refer to Drawings.
a. Normal Water Surface Elevation at effluent V-notch weirs: 1252.50± (West Unit), 1251.00± (East Unit)
b. Top of wall at effluent launder elevation: 1254.00± (West Unit), 1254.00± (East Unit)
c. Existing access stair landing elevation: 1259.00± (West Unit), 1257.50± (East Unit)
3. Center pier supported center drive type.
4. Manufacturer shall furnish complete flocculating clarifier mechanism system, including column support structure, influent stilling well, four-arm paddle flocculating mechanism, center drive unit assembly, access walkway and center platform with handrail and toeboard, center torque cage, rake arms, effluent v-notch weir, control panels, provisions for supporting wiring from the walkway, spare parts, and other necessary parts including anchor bolts, fasteners, and accessories.
5. Direction of Mechanism Rotation: Clockwise.
6. Direction of Flocculating Mechanism Rotation: Counterclockwise.
7. Operations: Capable of withstanding both continuous and intermittent operation.

8. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and manufacturer's service.

C. Performance Requirements:
   1. Collect and convey sludge to the sludge pocket.
   2. Operate satisfactorily under following conditions:

Design Parameter	Design Value
Influent Flow Rate (MGD)	3.5
Maximum Sedimentation Zone Surface Loading Rate (gpm/sf)	0.6
Maximum Flocculation Stilling Well Diameter (ft)	30
Flocculation Mechanism Rotational Speed Range (rpm)	0.5 to 1.0
Flocculation Mechanism Speed Turndown	2:1

D. Design Requirements:
   1. Gears, Bearings, Chains, and Sprockets shall be located at least 12 inches above maximum water surface.
   2. All gearing shall be completely enclosed and oil lubricated.
   3. Drive Mechanism: Design to allow removal of internal gears, balls, and strip liners without walkway bridge removal.
   4. Mechanism Construction:
      a. Shop welded, except at locations requiring periodic field adjustment and as approved.
      b. Welded Joints: Seal welded in shop. Field welding is not permitted.
      c. Welding: Conform to AWS D1.1/D1.1M requirements.
      d. Incorporate impacts of seal welding on structural design of mechanism, if any, into design.
   5. Stresses: Maximum 90 percent of material yield strength at Ultimate Torque load in members.
   6. Maximum Slenderness Ratio: 200 for compression member and 300 for tension member.
   7. Mechanism Design Running Torque: 26,500 foot-pounds minimum.
   8. Flocculating Paddles Design Running Torque: 5,000 foot-pounds minimum.
   9. Sludge Rake Arm Rotational Speed: Between 8 ft/min and 11 ft/min
   10. Capable of withstanding, without failure or permanent deformation of a part, Ultimate Torque rating as defined herein.
   11. The equipment shall be structurally designed to allow for temporary manual reverse rotation if necessary to relieve torque.The manufacturer shall provide warning signs, arrows indicating correct rotation, and labels at the drive unit clearly indicating that the drive is not intended for reverse rotation, however, the mechanisms including rakes, arms, and torque cage shall still be designed and constructed for manual reverse rotation. Reverse rotation is not an intended mode of operation.

2.4 CENTER PIER/ COLUMN

A. The center pier shall be capable of supporting the loads of the center drive mechanism, including sludge collecting equipment, and access bridge. The column shall be designed to support all loads imposed thereon, including torque and eccentric loads from rotating

mechanisms. The center pier shall be of the proper height to permit level installation of the access walkway and to support the turntable at least 12 inches above the maximum water level.

B. Steel: ASTM A36/A36M, 28-inch minimum outside diameter, wall thickness not less than 1/4 inch, extending continuously from base slab.

C. Ports:
   1. Minimum three (3) in top of column to release liquid flow and entrapped solids. Size and location determined by manufacturer.

D. Flange: Minimum 1-1/4”-inch thick, at base of center pier for anchoring to existing foundation by reuse of the existing anchor bolts, if possible, or by use of not less than six (6) new epoxy anchor bolts; size, spacing and number as determined by manufacturer.

2.5 INFLUENT STILLING WELL

A. Stilling (Flocculation) Well Material
   1. Steel plate, ASTM A36/A36M, minimum 3/16-inch thick and minimum 3/16-inch thick shapes.

B. Stilling Well Configuration:
   1. Maximum diameter of 30-feet.
   2. Extend a minimum of 6-inches above and a minimum of 12’-6” below static liquid level.
   3. Scum Release Ports: Minimum of four not less than 16 inches long and extending 3 inches above and 3 inches below static liquid level of manufacturer’s design.

C. Flocculation Units:
   1. Number of Units: One (1) per unit.
   2. Type: Vertical rotor paddles.
   3. Direction of Rotation: Counterclockwise.
   4. Number of Arms: Four, located 90-degrees apart from one another.
   5. Configuration: Concentric with rake arm drive and supported from the center drive platform.
   6. Flocculation well support arms shall have vertical paddles, spaced evenly between the drive cage and the stilling well. Spacing of the paddles shall be such that they permit paddles affixed to flocculation support arms to pass between them without interference.
      a. Paddles:
         1) Each paddle reel assembly shall consist of angle arms connected to the central drive shaft through 1/2" thick carbon steel gusset plates (if provided) welded to the shaft. The arms shall be fabricated from 3" (min) x 3" (min) x 1/4" (min) thick coated steel angles and shall be bolted with 5/8” (min) Type 316 stainless steel bolts to the gusset plates for paddle supports. Four arms shall be located 90-degrees apart from one another. The paddles shall be 6" wide coated steel channels. Paddles shall be fastened to the angle arms by means of Type 316 stainless steel bolts (1/2” min) and locknuts. All cut edges and holes in the paddles will patched and coated. The paddle arms shall be sized for a tip deflection of no more than L/360.

2.6 CENTER DRIVE UNIT ASSEMBLY

A. Ultimate Torque Rating: Not less than 2.0 times Design Running Torque.

B. Electric Drive Motor: Minimum 1/2 hp single speed motor and in accordance with Part 2.11.

C. The drive shall be designed to allow removal and replacement of internal gear and strip liners without raising the walkway.

D. Primary Speed Reducer:
   1. Horizontally mounted cylindrical-worm, helical-worm, or helical parallel (in-line) gear motor type with gears supported by antifriction bearings.
      a. Connect to secondary speed reducer via a chain drive system with drive sprocket directly mounted on its output shaft.
      b. Cycloidal reducer directly coupled to motor without use of chains and sprockets, and keyed to the pinion shaft is also acceptable.
   2. AGMA 6034.
   3. Service Factor: Minimum AGMA Class II applied to the input horsepower of the speed reducer when center drive unit is operating at specified Design Running Torque.
   4. Overhung Load Rating: Exceed chain pull by minimum 1.75 based on Ultimate Torque.
   5. Oil Fill, Drain, and Level Indicator Devices, and Lubricant: AGMA 9005, Food Grade.

E. Chain Drive (If Used):
   1. Roller Chain: Standard, ASME B29.100.
   2. Connect drive sprocket on primary speed reducer to driven sprocket on secondary speed reducer input shaft.
   3. Steel Sprockets: Minimum of 12 teeth.
   4. Chain:
      a. Service Factor: 1.2
      b. Power Transmission Rating: 1.75 times the input horsepower of chain drive when center drive unit is operating at specified Ultimate Torque.
   5. The chain drive shall be enclosed with a removable chain guard meeting OSHA requirements.
   6. Provision shall be made for adjustment of chain tension.

F. Secondary Speed Reducer (If Used):
   1. Cylindrical-Worm and Worm-Gear Type:
      a. Shafts supported by antifriction bearings and output shaft directly driving pinion gear of low-speed main bearing assembly.
      b. Planetary gear type units are not considered equal in design and are not acceptable.
   2. Load Capacity and Torque Rating: AGMA 6034.
   3. Design: AGMA 6022.
   4. Service Factor: Minimum AGMA Class II applied to the input horsepower of speed reducer when center drive unit is operating at specified Design Running Torque.
   5. Output Shaft: One-piece output extending through worm-gear and low speed main gear drive pinion without intermediate couplings.
   6. Worm: Steel, heat-treated, AGMA 2004, ground, and polished.
   7. Worm-Gear: Centrifugally cast, high-silicon bronze copper alloy, or ductile iron.
   8. Bearings: ABMA L-10, life of 180,000 hours minimum.
   9. Oil fill, drain, and level indicator devices, and lubricant conforming to AGMA 9005, Food Grade.

10. Enclosure: ASTM A48/A48M, Class 40 minimum housing, and registered fit-mounted to gear head drive platform. Swivel base mounting of the intermediate unit will not be acceptable.

G. Cycloidal Speed Reducer (If Used):
   1. Cycloidal or Helical Speed Reducers: Cycloidal types shall be directly connected to a motor without the use of chains or V-belts and shall be keyed to the pinion. The movement of the cycloid disc shall be transmitted by pins to the low speed shaft. The pinion shall be supported radially by a bearing at the bottom end. No overhung pinions shall be allowed on the speed-reducing unit. The lower pinion bearing shall not be located below the turntable base. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and shall be run in a totally submerged oil bath.
   2. Main Ring Gear:
      a. High-carbon chromium bearing steel.
      b. Fixed-to-drive casing.
      c. The gear shall be designed to a minimum AGMA 5 rating, per AGMA standard 2001-B88, for strength and surface durability, based on a life of 180,000 hours.
   3. Eccentric Bearing: Mounted to high-speed shaft, roll cycloidal discs around internal circumference of main ring gear.
   4. Cycloidal Disc Lobes: Engage successively with pins in fixed ring gear.
   5. Helical Gearing: The gearing shall be designed to a minimum AGMA 5 rating, per AGMA standard 2001-B88, for strength and surface durability, based on a life of 180,000 hours, and bare and AGMA nameplate.
   6. Service Factor: Minimum AGMA Class II, based on drive output torque rating.
   7. Oil Lubricated Radial and Thrust Bearings: Sized for mechanism loads specified herein and run in a totally submerged oil bath.

H. Dual Drive Unit (If Used):
   1. Each center drive assembly shall be made up of individual, concentric, counter rotating sludge collector and recirculation turbine drives, designed to attach to support beams with leveling bolts. Drives shall be in totally enclosed housings with sludge collector and recirculation turbine drives separate, to allow independent maintenance and lubrication.
   2. The dual drive unit shall be manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values previously listed. It shall turn the mechanism at the design collector and turbine tip speeds. The drive main bearings shall be designed for the total rotating mechanism loads with a minimum L-10 life of 180,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque for the rake drive and two times the running torque for the turbine drive while starting. The drive main gears shall be designed to a minimum AGMA 5 rating when rated in accordance with AGMA 2001-B88.
   3. All gearing shall be designed per AGMA standard 2001-B88 for strength and surface durability based on a life of 180,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the two values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.
   4. All bearings shall run in an oil bath. Provision shall be made for condensate collection below the main bearings and gears to positively prevent the bearings and gears from

running without proper lubrication. Sight glasses and condensate drains for each drive shall be easily accessible without removing plates or structures.

5. Drive components will be located via a machined, registered fit or pilot to insure proper alignment.
6. Any welding on the drive unit shall be done using E70XX weld rod.

I. Low Speed Final Reduction Unit (if used):
   1. Enclosed turntable, balls in main bearing annular radial thrust raceway type, balls in compression and renewable strip liners or continuous multipoint contact contoured raceway type with hardened surfaces and balls in shear (precision bearing).
      a. Ring Gear: Internal or External toothed, spur pinion gear driven, attached to secondary speed reducer output shaft.
   2. Low Speed Gearset:
      a. Design and Rated: AGMA 2001.
      b. Power Rating:
         1) Lower of pitting resistance and bending strength ratings for pinion and gears.
         2) Based upon continuous 24 hours per day service at Design Running Torque for 180,000 hours minimum.
         3) Include ability to withstand, without failure or permanent deformation, Ultimate Torque Rating.
      c. Spur Pinion Gear:
         1) Steel: Heat-treated; integral with or keyed to its shaft.
         2) Wall Thickness (Above Keyway): Minimum depth of one tooth.
      d. Ring Gear:
         1) Solid one-piece or split construction of ductile (nodular) iron (ASTM A536), cast steel (ASTM A148/A148M), or heat-treated alloy steel.
         2) Split Gear Construction:
            a) Machined, minimum two alignment dowels, joined with high strength galvanized steel bolts.
            b) Allowable Stresses (Calculated): Reduced to 85 percent joint efficiency for split gear construction.
         3) Bolt to center torque cage that supports and rotates collection mechanism.
      e. Teeth: Full depth, AGMA 2001; stub-pitch and undercut gear teeth not acceptable.
   3. Main Bearing:
      a. Ball Raceway Diameter: Minimum 45 inches, low unit ball load and stability without guide shoes or steady bearings.
      b. Raceways and Balls: ABMA L-10 life of minimum 180,000 hours when operating continuously at Design Running Torque.
      c. Load Carrying Balls:
         1) Steel: Chrome alloy, hardened to 60-65 Rockwell C.
         2) Diameter: Minimum 1-1/2 inches. If all balls are load-carrying, 1-inch diameter balls will be acceptable.
         3) Crushing Strength: Minimum 120,000 pounds.
      d. Spacer Balls (if required): 1/16-inch lesser diameter than, and of same material as, load carrying balls.
         1) Balls: Field replaceable without access walkway removal.
      e. Raceways:

1) Four vacuum degassed high carbon steel renewable liner strips force fit (pin or capscrew attachments not acceptable) into base and ring gear, and specially hardened to 38-48 Rockwell C. Strips shall have minimum dimensions of 1/4 inch thick by 1/2 inch wide**.**

2) Deep grooved, fully contoured design, match bearing balls. Heat treated steel, minimum tensile strength of 120,000 psi, hardness of 250-300 Brinell, and surfaces heat treated to 55-60 Rockwell C.

4. Ring Gear, Pinion Gear, and Main Bearing Ball Races:
   a. Oil bathed, steel or neoprene dust shield, and felt seal protected.
   b. Oil Fill, Drain and Level Indicator Devices, and Lubricant: AGMA 9005, Food Grade.
   c. Casing with manual condensate drain.
5. Oil filling and level pipe, drain plug, and sight gauge. Attach pipe to turntable bottom within base center for easy access.

J. Turntable Base and Housing:
1. Design to bolt to center column, support entire rotating collector mechanism, transmit mechanical design strengths, support main bearing assembly and one end of access walkway, and form center platform for convenient access to drive unit components.
2. Platform: 36-inch minimum clear walking and working surface outside all sides of drive unit components mounted at platform.
3. Cast Iron: Gray, ASTM A48/A48M, Class 40 minimum or Steel: ASTM A36/A36M, 3/8-inch thick.

K. Mechanism Overload Device:
1. Mechanical or Hydraulic: Actuate integral contacts to indicate impending overload and shutoff drive motor at predetermined load.
2. Impending Overload Contact (Alarm Torque): Actuate at 90 percent of Design Running Torque.
3. Motor Shutdown Contact (Cutout Torque): Actuate at 120 percent of Design Running Torque.
4. Contacts: Single-pole, double-throw rated 5 amps, 120V ac.
5. Enclosure: NEMA 250, Type 4X, Type 316 stainless steel or cast aluminum.
6. Indicating Pointer: Indicate relative load on graduated scale up to Ultimate Torque.
7. Provide a backup motor cutout switch to protect drive unit in case of control system failure. Actuate at 130 percent of Design Running Torque.
8. Wire contacts to local control panel specified herein.

2.7 ACCESS WALKWAY

A. General: Provide access walkway from side of flocculating clarifier to center drive unit and access platform around center drive unit.

B. Support System:
1. All-welded hot-dip galvanized steel rolled wide flange beam or truss beam type bridge construction supported rigidly on center pier and at access end on flocculating clarifier wall with thermal expansion compensating anchorage.
2. Diagonally cross brace against lateral loads and space beams as necessary to carry loads and produce required clear walkway width.

C. Bridge Design:

1. Maximum Vertical Deflection: 1/360 of span under uniform 50-pound per square foot of walkway surface live load, plus all dead loads applied to the bridge including the bridge dead load. Camber for 1/3 live load plus dead load.
2. Maximum Horizontal Deflection: 1/360 of span under uniform horizontal loading of 50 pounds per linear foot and under torsional loadings from the center drive under Ultimate Torque mechanism loading.
3. Horizontal and vertical design live loads shall be applied simultaneously.
4. Walkway Surface Elements: Do not use to reduce calculated bridge deflections.
5. Contractor shall coordinate with equipment manufacturer to integrate the access walkway with the existing landing such that the access walkway and existing stair landing are at the same elevation.

D. Walkway Surface:
1. Material: Aluminum grating with slip resistant coating
2. Thickness: Minimum, 1-1/4-inch by 3/16-inch.
3. Width: Extend to guardrail/handrail supports.
4. Grating shall be removable.

E. Center Drive Platform Surface: The center platform surface shall be removable, 3/8-inch, slip-resistant, aluminum checkered floor plate, attached to a structural steel frame with necessary stiffeners and supports, resting on the center assembly.

F. Width:
1. Access Walkway: 36 inches minimum clearance between guardrails/handrails.
2. Center Drive Platform: 36 inches minimum clear working space between handrail and all parts of drive machinery and controls.

G. Guardrails:
1. Anodized aluminum
2. Extend along both sides of bridge and around center drive platform.
3. Attach top and intermediate rails specified to bridge elements using standard premanufactured wall bracket units.
4. Bridge truss may be used in lieu of a fabricated guardrail along both sides of bridge provided that it meets OSHA and other code requirements regarding guardrail design, including load capacity, maximum opening size, height, and provision of toeboard. Fabricated guardrail is required around the access platform.

H. Toeboards:
1. Anodized Aluminum: 4 inches high by 1/4 inch minimum thickness.
2. Fasteners: Type 316 stainless steel.
3. Locate around center platform perimeter and full length of both sides of access walkway.

2.8 CENTER CAGE

A. All-welded ASTM A36 steel box truss design and constructed of components not less than 1/4-inch thick. The cage shall be suspended vertically from and receive its rotational power from the center drive unit mounted on the operating platform.

B. Supports and rotates rake arms, and fastens to main gear with bolted connections. The rotating cage shall have adequate structural strength to support the entire rotating mechanism. Design shall accommodate dead load plus live load and torque with an adequate factor of safety to eliminate deflection or vibration.

C. Designed to withstand the Ultimate Torque Load of the drive without overstressing the members in design direction.

D. Designed with sufficient strength and rigidity such that with 60/40 percent load imbalance at Ultimate Torque Load; no member will be stressed to a level beyond maximums allowed by current AISC Specifications.

E. Connections to Rake Arms: Adjustable and bolted.

F. Sludge Hopper Concentrators
   1. Quantity: Four at 90-degrees
   2. Connection to cage: adjustable and bolted.
   3. Squeegees as specified below.

2.9 RAKE AND FLOCCULATION WELL SUPPORT ARMS

A. Full radius, all-welded steel triangular or diagonally braced box truss design that supports and rotates sludge scraper blades and the flocculation paddles. Support from center torque cage. Use of tie rod supports is not acceptable. The minimum thickness of members shall be 1/4-inch. Minimum angle size shall be 2-inch by 2-inch. The rake arm blades shall have a minimum depth of 9-inches.

B. Partial radius, all-welded steel triangular or diagonally braced box truss design that supports and rotates the flocculation well support paddles. Support from center torque cage. Use of tie rod supports is not acceptable. The minimum thickness of the members shall be 1/4-inch. Minimum angle size shall be 2-inch by 2-inch.

C. To ensure alignment and connection to the center torque cage, the width of the rake collector arms and flocculation well support arms shall be approximately the same as the center torque cage. The rake and flocculation well support arms shall be connected to the center drive cage in such a manner that each arm can be easily removed completely or adjusted both vertically and angularly to conform to the angle of the tank floor. Furnish shims as necessary to adjust arms angle during construction by the General Contractor. The arms shall not incorporate the use of tie rods or yoke connections.

D. Quantity: Two rake arms, located 180-degrees apart. Two flocculation well support arms, located 180-degrees apart (90-degrees apart from rake arms).

E. Rake Arm Sludge Scraper Configuration: A series of plow blades. Each blade shall be oriented at an angle to direction of travel and having sufficient length and spaced as necessary to effectively move sludge from one blade to next toward center of the unit with each pass. Rake blades shall be properly spaced to insure complete raking of the tank bottom twice per revolution.

F. Designed to withstand the Ultimate Torque Load of the drive without overstressing the members turning in the design direction.

G. Sufficient strength and rigidity such that at Ultimate Torque no member will be stressed to level beyond maximums allowed by current AISC Specifications.

H. Deflection:
   1. Maximum Allowable Net Vertical Deflection: 0.25 inch at cutout torque.
   2. Maximum Allowable Horizontal Deflection: L/200 at cutout torque.

3. Truss shall be specifically designed to meet the above deflection limitations under the loadings unique to the scraper configuration used. Compliance with above deflection limits shall be met via structural calculation submittals.

I. Steel: ASTM A36/A36M, angular elements.

J. Squeegees:
1. Materials: Minimum 26-gauge, spring brass or Type 304 stainless steel.
2. Minimum adjustment of 2-inches in the vertical plane.
3. Attached to steel sludge scraper blades.
4. Bolts, Nuts, and Washers: Type 316 stainless steel.
5. Vertical Alignment: Between 1/4-inch minimum and 3/4-inch maximum clearance above the grouted bottom.
6. Connection Bolts: Type 316 stainless steel.

K. Thickening Flights
1. Quantity: Two, connected to rake arms.
2. 1/4-inch by 6” deep steel flights with squeegees as specified above.
3. Located in the 30’-0” recessed sloped section of the clarifier.
4. The minimum thickness of members shall be 1/4-inch. Minimum angle size shall be 2-inch by 2-inch
5. Connection to rake arms: bolted and adjustable.

2.10 WEIR PLATES

A. Reuse existing weirs. Contractor shall protect weirs during the installation of the mechanism. Weirs should remain in place and shall not be removed from the clarifier structure.

B. Coat: Exposed portions of the weir per Section 09 90 00, “Painting and Protective Coatings”.

2.11 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 40 05 93, “Common Motor Requirements for Process Equipment” for motors, 600 volts and lower, and 250 HP and smaller.

B. If a motor horsepower rating larger than specified is offered as a substitute and accepted, provided required changes in conductors, motor controllers, overload relays, fuses, switches and other related items with no change in the Contract price.

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven loads will not require motor to operate in service factor range above 1.0.

2.12 CONTROL PANEL AND INSTRUMENTATION

A. All instrumentation, control and electrical components provided under this section shall comply with the requirements on the Drawings and Division 40 Sections.

B. Control Panel
1. General: Refer to Section 40 05 91, Common Control Panel Requirements for Process Equipment for the general requirements of the Flocculator-Clarifier Control Panel. Control panel shall also include all required transformers, controls, starters, breakers, variable frequency drives, and related electrical components required for electric motors.

2. Panels: Provide control system for equipment system, but not limited to, for monitoring the following instruments and controls. This list is not intended to completely depict all of the functional requirements of the control system provided under this Section. The system supplier shall provide all additional instrumentation and controls necessary to produce a safe and operable system. Supplier shall provide duplicate control panels to be located inside at the Water Treatment Plant. Duplicate control panels shall match the control panels located at each clarifier.
    a. Local Control Panel
        1) Controls shall be mounted on panel face.
        2) Panel shall be NEMA 4X 304 stainless steel, coated with a white powder coating with three point latching handle.
        3) Panel shall be 480 volt, 3-phase, 60 Hz electrical service.
        4) Panel shall have the following controls mounted on the panel face**.**
            a) Clarifier
                - ON/OFF/REMOTE switch.
                - RUN, Fail, and OFF push-to-test LED indicating lights.
                - Over-torque Alarm and Over-torque Trip push-to-test LED Indicating lights
                - Fail reset button.
                - Elapsed Time Meter.
            b) Flocculator
                - ON/OFF/REMOTE switch.
                - Push-to-stop emergency stop button, for each flocculator.
                - RUN, VFD Fail, and OFF push-to-test LED indicating lights, for each flocculator.
                - Elapsed Time Meter, for each flocculator.
                - VFD keypad, for each flocculator.
        5) Panel shall be provide with the following devices:
            a) Main Panel Circuit Breaker
            b) Fused 1 KVA sealed control power transformer.
            c) Two (2) 120V.15A/1P spare breakers.
            d) Thermostatic controlled condensation heater.
            e) Thermostatic controlled air conditioning unit.
            f) LED flashing beacon mounted on top of the enclosure.
        6) Provide the following Inputs:
            a) Remote start command of the clarifier
            b) Remote start command of the flocculator
            c) Remote speed command of the flocculator
        7) Provide the following outputs:
            a) Run and Fail status of the clarifier
            b) Over-torque Alarm and Over-torque Trip of the clarifier
            c) Position of the On/OFF of the clarifier
            d) Run and Fail Status of each flocculator
            e) Speed indication of each flocculator
    b. Remote Control Panel
        1) Controls shall be mounted on panel face.
        2) Panel shall be NEMA 4X 304 stainless steel, coated with a white powder coating with three point latching handle.
        3) Panel shall be 120 volt, 1-phase, 60 Hz electrical service.

4) Panel shall have the following controls mounted on the panel face.

a) Clarifier

- ON/OFF switch.
- RUN, Fail, and OFF push-to-test LED indicating lights.
- Over-torque Alarm and Over-torque Trip push-to-test LED Indicating lights
- Fail reset button.
- Elapsed Time Meter.

b) Flocculator

- ON/OFF switch.
- RUN, VFD Fail, and OFF push-to-test LED indicating lights, for each flocculator.
- Elapsed Time Meter, for each flocculator.
- Speed indication
- Speed setpoint.

2.13 DISSIMILAR METALS

A. Manufacturer shall be responsible for protection from corrosion as a result of dissimilar metals. Isolate dissimilar metals or connectors to prevent direct contact and electrical conductivity.

1. Use 1/8-inch-thick continuous neoprene gasket or 3M Scotchrap Tape 51 with pipe primer to insulate aluminum gratings, checker plate, and handrail post bases from access walkway support bridge and other components.
2. Use insulating washers and Teflon sleeves at bolted connections.

2.14 ACCESSORIES

A. Anchor Bolts: The manufacturer shall furnish all anchor bolts, nuts and washers required for the equipment. Provide template for settling all anchorage. Provide coated Type 316, stainless steel bolts, sized by equipment manufacturer and at least 1/2 inch in diameter or as shown, in accordance with Section 05 50 00 “Metal Fabrications”. Coat in accordance with Section 09 90 00 “Painting and Protective Coatings”.

B. Equipment Identification Plates: Provide 16-gauge, Type 304 stainless steel, identification plate securely mounted on drive units in a readily visible location with 3/8-inch-high, engraved block type, black enamel filled letters, that read “Flocculating Clarifier 1” and “Flocculating Clarifier 2”, respectively.

2.15 FABRICATION

A. General: Fabricate bridge beam or stringer sections in continuous unbroken pieces.

B. Shop Assembly:

1. Shop fabricate and assemble mechanism components in largest sections practicable and permitted by transportation carrier regulations.
2. Properly match-mark units for ease of field erection. The shop drawings shall clearly indicate the number of subassemblies proposed for each mechanism and the contents.
3. Sharp projections of cut or sheared edges shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coatings adherence.

4. Completely assemble center drive unit in manufacturer's shop and test, to the furthest extent possible, to ensure proper operation, and calibration of torque controls.
5. Completely shop assemble and test control panels.
6. Fasteners: Type 316 stainless steel.
    a. Apply appropriate anti-seize compound to the threads during assembly.
    b. Do not assemble bolted connections until the final coating system has been applied to mating surfaces and cured.
7. Hot-Dip Galvanize after Fabrication:
    a. Steel access walkway support/bridge system in conformance with Section 05 50 00 "Metal Fabrications".
    b. Field cutting or welding of galvanized parts will not be permitted.

C. Shop/Factory Finishing:
1. Shop prepare, prime, and stripe coat ferrous metal as specified in Section 09 90 00 "Painting and Protective Coatings", for submerged surfaces and for nonsubmerged, nongalvanized surfaces.
2. Exposed Metal Surfaces of Motors, Gear Reducers: Factory prepare, prime, and finish coat in accordance with Section 09 90 00 "Painting and Protective Coatings".
3. Provide shop-applied coatings by same manufacturer for compatibility.
4. All submerged surfaces shall receive independent NACE certified inspection of prime coat prior to shipment.

D. Field Finishing:
1. Field finish ferrous metal as specified in Section 09 90 00 "Painting and Protective Coatings", for submerged surfaces and for nonsubmerged, nongalvanized surfaces.
2. All submerged surfaces shall receive independent NACE certified inspection of finish coat after installation.

E. Welded Construction:
1. Mechanism component interfaces that are not field bolted connections: seal weld in shop or field. Welded connections shall develop the full strength of the connected elements, and joined or lapped surfaces shall be completely seal welded with a minimum 3/16-inch fillet weld and wrapped. Skip welding shall not be allowed.
2. Welding: As specified in Section 05 50 00 "Metal Fabrications".
3. Welding: Comply with AWS D1.1/D1.1M for procedures, appearance, quality of welds, and methods used in correcting welding.

2.16 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Adjustments: Calibrate torque controls.

C. Provide CWI inspection whenever shop welding is performed including:
1. Monitor conformance with approved welding procedure specifications.
2. Monitor conformance of welder/welding operator qualifications.
3. Inspect weld joint fit-up and provide in-process inspection.
4. Provide 100 percent visual inspection of all welds in accordance with AWS D1.1/D1.1M, Paragraph 6.9.
5. Maintain records and prepare report confirming results of inspection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and adjust in accordance with the plans, approved shop drawings, equipment manufacturer's written instructions, and the supplemental requirements included herein.

B. Remove temporary bracing supports and other construction debris that may damage equipment (if applicable).

C. Remove protective Coating and oils used for protection during shipment and installation (if applicable).

D. Check equipment for correct direction of rotation and freedom of moving parts.

E. Align equipment to manufacturer's tolerances.

F. Adjust, balance, calibrate and verify that the equipment, safety devices, controls, and process system operate within the design conditions. Each safety device shall be tested for proper setting and signal. Response shall be checked for each equipment item and alarm. Simulation signals may be used to check equipment and alarm responses.

3.2 CLARIFIER BASIN FLOOR

A. Clarifier Basin Floor Preparation
   1. Contractor shall remove existing grout during demolition of the existing mechanism.
   2. Floor Tolerance: Plus or minus ¼ inch of level from side to side and plus or minus ¼ inch of flat across the surface with a smooth finish.
   3. After installation of the sludge collector mechanism, cap the floor with a 2-inch minimum NSF 61 certified grout, bringing the floor back to level, and using the sludge collector mechanism, smooth the grout to the required tolerances.

B. Grouting Procedures
   1. Floor Grout: The collector mechanism shall be detailed to allow clearance for a grout topping to be applied to the rough floor of the settling basins. The purpose of the topping is to provide a smooth uniform floor and a precision fit to the scraper blades. The grout topping shall be nominally 2-inch thick adjusted as required to fit the mechanism, but will be thicker in some areas to level tank floor.
   2. The collector arms and rotating mechanism shall be carefully leveled and adjusted in accordance with the manufacturer's written instructions and as directed in the field by the manufacturer's technical service personnel prior to placement of the floor grout. Grout topping is to be applied before installation of the flight squeegees.
   3. The sludge hopper, sludge draw off piping, floor drains and other floor fittings shall be carefully protected by plywood forms and sand bags prior to placing the grout topping.
   4. A screed board shall be placed on one arm which shall be used to finish the floor.
      a. Board shall be well braced and sturdy and shall be of minimum 2 x 6 new material carefully spliced with beveled joints and 1 x 4 splice plates so that the bottom edge is continuous and will not leave ridges at the joints.
      b. Board shall attach to the steel flights with 2 x 4 nailers which are to be bolted to the squeegee mounting holes with at least two bolts. The screen board shall be face nailed to the beveled ends of the nailer forming a sturdy joint. Additional 2 x 4 bracing shall be fitted at right angles to the nailer supporting the mid span of the screed board. The brace shall be face nailed to the screen board and toe nailed to the bolted nailer.

c. The lower edge of the screed board shall have a 3/8-inch bevel facing the direction of motion to provide a sharp edge for finishing the floor. The beveled edge shall be covered with a 26-gauge metal flashing fitting tightly around the wood edge and nailed to the screen board.

d. The lower edge of the screed board shall project 2-1/2 inches from the bottom of the steel flights which shall be adjusted such that the bottom edge of the screed board is not less than 1-inch from the rough floor at any point and is nominally 2-inches from the rough floor.

5. Any existing grout shall be removed prior to installation of new grout layer. The rough floor shall be thoroughly cleaned and washed down prior to the grouting operation. Sandblasting or muriatic acid etching shall be used as needed to remove paint or other hard to remove substances from the rough floor.

6. Epoxy bonding agent Sikadur 32 Hi-Mod shall be liberally applied as directed on the container to dampen the floor sections prior to grouting. This material shall be broomed evenly on to the rough floor just ahead of the grout operation.

7. The floor grout shall be a mixture of sand and Portland cement in the ratio of three parts sand to one part cement with a 6-inch to 7-inch slump or just fluid enough to flow evenly without losing adhesion to the floor. Any grout admixtures shall be NSF 61 certified and in accordance with Section 03 30 00, Cast-In-Place Concrete.

8. Personnel working in front of the rotating arms shall spread the grout ahead of

9. the screen board maintaining a 3-inch to 4-inch crest of material in front of the board to prevent pockets from forming behind the screen. Care shall be taken not to disturb the arms of the mechanism by standing on the arms or allowing an excessive grout build up which could cause an uneven floor.

10. After grouting, the finished floor shall be kept damp and cool to minimize shrinkage cracks.

11. A hand trowel finish is not required provided the finished floor is reasonably smooth and uniform with 2-1/2 inch (+ 1/2 inch) clearance from the floor to the bottom of the steel scrapers at all locations. Any areas exceeding this tolerance shall be hand finished as directed by the Engineer.

C. After completion of the floor grouting, the adjustable squeegees shall be installed and adjusted to provide a nominal 1/2-inch clearance from the squeegees to the finished floor.

3.3 FIELD FINISHING

A. Touch up damaged coatings using same coating and color that was factory or field applied, in accordance with Section 09 90 00 “Painting and Protective Coatings”.

B. Touch up minor scratches and scrapes in galvanizing finishes using at least 3 mils of zinc rich compound conforming to Federal Specification MIL-P-21035 or MIL-P-26915A. Clean surface with wire brush and wipe with clean damp rag. Allow to dry before application.

3.4 FIELD QUALITY CONTROL

A. Functional Tests:

1. Conduct on the drive mechanism and flocculators.
2. Operate the equipment through the design performance range consistent with available flows.
3. Operate mechanism for continuous 8-hour period without malfunction.

B. Performance Test:

1. Conduct on each completed assembly in accordance with accepted test procedures.
2. Perform to confirm mechanical and structural compliance with specified torque requirements.
3. Conduct static torque test on mechanism. With the clarifier drive shut off, connect a load measurement device to each rake arm at a specific radial distance from the center using nylon straps, and attach the other end of each of the two loading assemblies to a temporary anchor installed in either the clarifier wall or floor. Apply a load to the rake arm by tightening both assemblies using a come-along or similar device. Load both arms simultaneously. Convert loadings as read on the load measurement devices to torque using the following formula (which assumes both arms are loaded simultaneously):

   $T = P_1 * D_1 + P_2 * D_2$

   Where:

   T = torque, ft-lb

   P_1, P_2 = Load applied at each connection point, lb (should be equal)

   D_1, D_2 = Radial distances on rake arms to attachment points (should be equal)
4. Set the alarm and cutout torque switches at the corresponding back-calculated loadings, and measure the clarifier mechanism deflection against the specified limits.
5. Record scale indications and/or mark scale for alarm and cutout torques.
6. Submit test report containing results.
7. Manufacturer may suggest alternate testing procedure, subject to Engineer's approval.

3.5 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Qualified field representative present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:
   1. 1 person-days for installation assistance, inspection after installation, and troubleshooting.
   2. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   3. 0.5 person-day for prestartup classroom or Site training.
   4. 1 person-day for facility startup.
   5. 0.5 person-day for post-startup training of Owner's personnel. Training shall not commence until accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Division 1 Section 01 43 33 "Manufacturers' Field Services" and Section 01 75 25 "Equipment Testing and Facility Startup."

END OF SECTION

Appendix A – Drawings

(The following are for information only)

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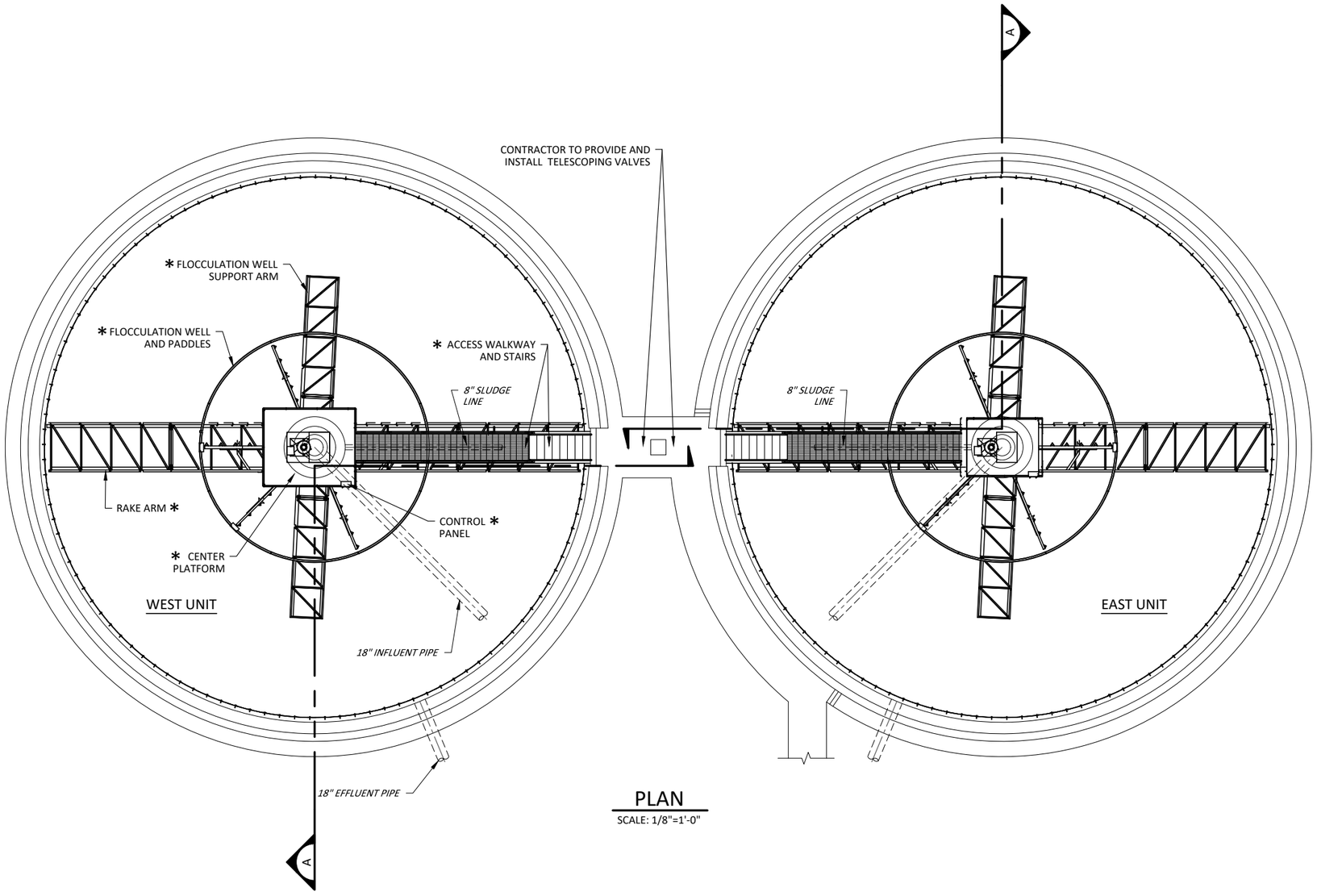

PLAN

SCALE: 1/8"=1'-0"

NOTES BY SYMBOL:

* INDICATES EQUIPMENT PROVIDED BY PR-SELECTED EQUIPMENT SUPPLIER.

NOTES:

1. THE EAST UNIT IS AN ADDITIVE BID ITEM. EQUIPMENT TO BE SUPPLIED BY THE VENDOR SHALL MATCH EQUIPMENT IN THE WEST UNIT IF ELECTED TO BE REPLACED BY THE CITY.

PLUMMER
531 COUCH DR, STE 200 | OKLAHOMA CITY, OK 73102
405.440.2725 | OKLAHOMA FIRM NO. 1097

NO.	DATE	REVISION	BY

CITY OF DEL CITY
FLOCCULATING CLARIFIERS REPLACMENT

MECHANICAL
FLOCCULATING CLARIFIER PLAN

THESE DOCUMENTS ARE FOR INTERIM REVIEW AND ARE NOT INTENDED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.
JASON LAUBACHER
OKLAHOMA P.E. NO. 33527
DATE: 12/22/2023

IF THIS BAR DOES NOT MEASURE ONE INCH, DRAWING IS NOT TO LABELED SCALE

DESIGNED T. JENSEN
DRAWN F. CAVE
CHECKED J. LAUBACHER
REVIEWED M. PLUNK

Seq.

Dwg. No. M-100

3298-001-01

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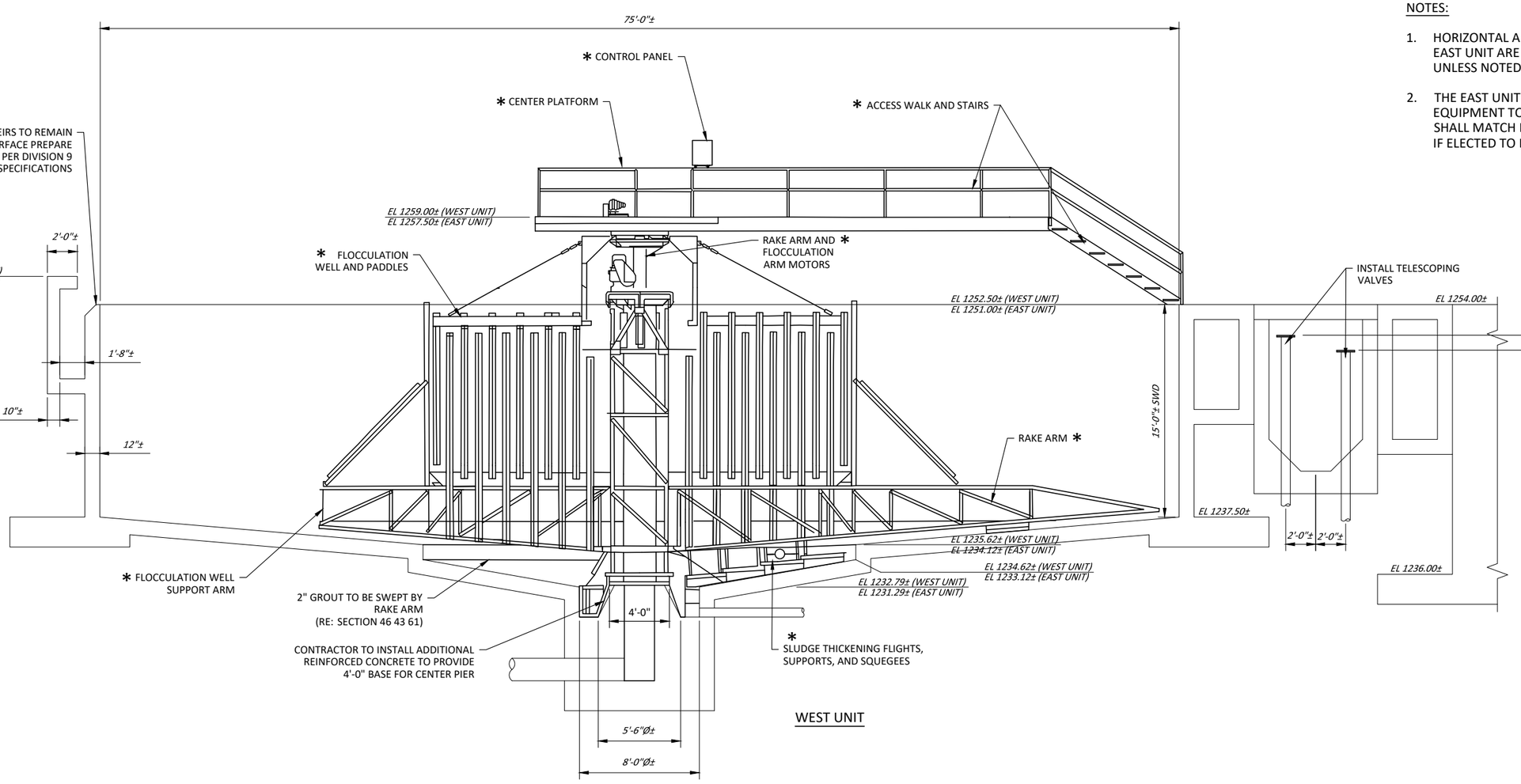
NOTES BY SYMBOL:

* INDICATES EQUIPMENT PROVIDED BY PR-SELECTED EQUIPMENT SUPPLIER.

NOTES:

1. HORIZONTAL AND VERTICAL DIMENSIONS FOR EAST UNIT ARE THE SAME AS THE WEST UNIT UNLESS NOTED OTHERWISE.
2. THE EAST UNIT IS AN ADDITIVE BID ITEM. EQUIPMENT TO BE SUPPLIED BY THE VENDOR SHALL MATCH EQUIPMENT IN THE WEST UNIT IF ELECTED TO BE REPLACED BY THE CITY.



WEST UNIT

SECTION A M-100

SCALE: 1/4"=1'-0"

PLUMMER

531 COUCH DR. STE 200 | OKLAHOMA CITY, OK 73102
405.440.2725 | OKLAHOMA FIRM NO. 1097

NO.	DATE	REVISION	BY

CITY OF DEL CITY

FLOCCULATING CLARIFIERS REPLACMENT

MECHANICAL

FLOCCULATING CLARIFIER SECTION

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JASON LAUBACHER

OKLAHOMA P.E. NO. 33527

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DESIGNED T. JENSEN
DRAWN F. CAVE
CHECKED J. LAUBACHER
REVIEWED M. PLUNK

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