Simplified Passive Advanced Light Water Reactor Plant Program

1990 Program Work Plan

Prepared for

U.S. Department of Energy
San Francisco Operations Office

DE-AC03-90SF18495
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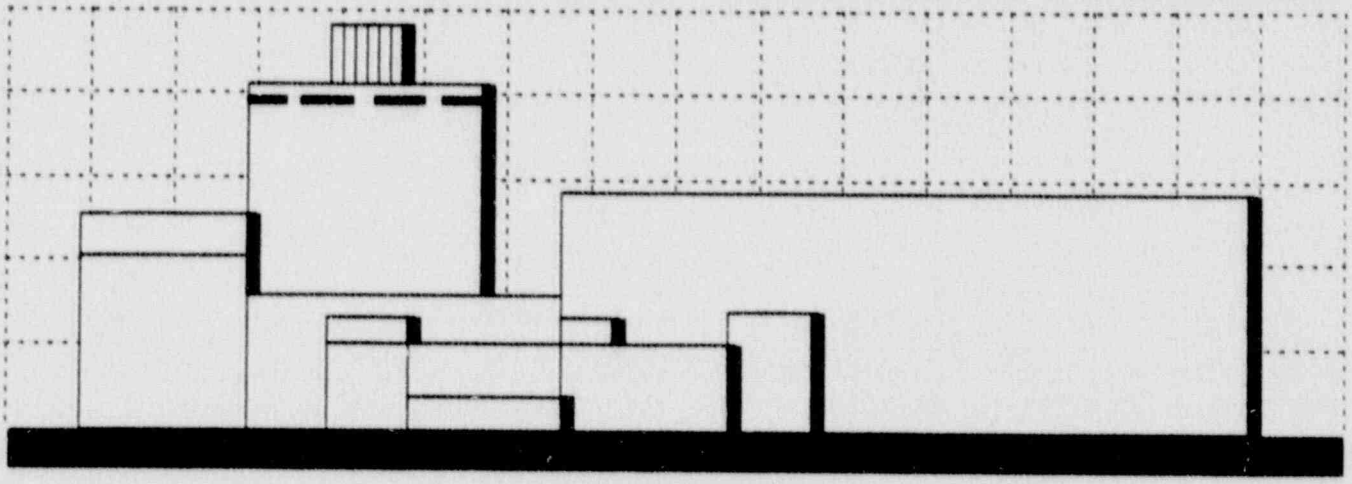

Westinghouse Electric Corporation

003 32220A

1990 Program Work Plan

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*To be submitted later.

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LIST OF TABLES AND FIGURES

List of Acronyms

ACRS	Advisory Committee on Reactor Safeguards
ACWP	actual cost of work performed
ADS	automatic depressurization system
AE	Architect-Engineer
AEP	American Electric Power Co., Inc.
AFL	approved for layout
AFUDC	allowance for funds used during construction
AFWS	auxiliary feedwater system
ALARA	as low as reasonably achievable
ALMR	advanced liquid metal reactor
ALWR	advanced light water reactor
AMSAC	anticipated transient without scram mitigation system circuit
ANSI	American National Standards Institute
APWR	advanced pressurized water reactor
ARSAP	Advanced Reactor Safety Analysis Program
ASLB	Atomic Safety and Licensing Board
ASME	American Society of Mechanical Engineers
ATWT	anticipated transient without reactor trip
BAC	budget at completion
BCWP	budgeted cost of work performed
BCWS	budgeted cost of work scheduled
BOP	balance-of-plant
BWR	boiling water reactor
CA	cost account
CAD	computer-aided design
CADD	computer-aided design drafting
CAE	computer-aided engineering
CAM	Cost Account Manager
CAP	Cost Account Plan
CBB	contract budget baseline
CCB	Configuration Control Board
CCNG	combined cycle, natural gas
CCWS	component cooling water system
CDF	core damage frequency
CDRL	Contract Data Requirements List
CFR	Code of Federal Regulations
CM	configuration management
CMP	Configuration Management Plan
CMT	core makeup tank
CNFD	Commercial Nuclear Fuel Division (Westinghouse)
C.O.DATE	commercial operation date
CPM	critical path method
CPR	Cost Performance Reports
CPSR	contractor procurement systems review
CR	control room
CR	constructibility reviews
CRBRP	Clinch River Breeder Reactor Project
CRDM	control rod drive mechanism
CSCS	Cost and Schedule Control Systems
C/SCSC	Cost and Schedule Control Systems Criteria
CVCS	chemical and volume control system
CWBS	Contract Work Breakdown Structure
DBD	Design Basis Document
DC	design certification
DCAA	Defense Contract Auditing Agency
DECLG	double-ended cold leg guillotine
DNB	departure from nucleate boiling
DNBR	departure from nucleate boiling ratio
DOD	Department of Defense
DR	design review
DRC	Design Review Committee
DSER	Draft Safety Evaluation Report
DWPF	Defense Waste Processing Facility
EAC	estimate at completion
EBR-1	experimental breeder reactor
ECB	emergency control board
ECCS	emergency core cooling system
ECN	engineering change notice
ECP	engineering change proposal
ECR	emergency control room
ECRHS	emergency control room habitability system
EFWS	emergency feedwater system

EMD	Electro-Mechanical Division (Westinghouse)
EPRI	Electric Power Research Institute
ERDA	Energy Research and Development Administration
ERG	Emergency Response Guidelines
ESBU	Energy Systems Business Unit (Westinghouse)
ESF	engineered safety features
ESFAC	engineered safety features actuation circuitry
ETC	estimate to complete
FAR	Federal Acquisition Regulation
FCE	fair cost estimate
FDA	Final Design Approval
FFTF	Fast Flux Test Facility
FMEA	failure modes and effects analysis
FMECA	failure modes, effects, and criticality analysis
F/O	fold/out
FSAR	Final Safety Analysis Report
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	fiscal year
G&A	general and administrative
GDC	general design criteria
GO	a computer code for performing reliability analysis
GOCO	government-owned, contractor-operated
GSI	generic safety issues
GWPS	gaseous waste processing system
HEDL	Hanford Engineering Development Laboratory
HVAC	heating, ventilating and air-conditioning
I&C	instrumentation and control
ICD	Interface Control Document
ICIS	in-core instrumentation system
IC/MMI	instrumentation and control/man-made interface
ICWG	Interface Control Working Group
ID	inner diameter
IDCOR	Industry Degraded Core Rulemaking Program
IMACS	integrated management and control system
INEL-DOE	Idaho National Engineering Laboratory-Department of Energy
IPMS	integrated project management system
IPS	integrated protection system
IR&D	Internal Research & Development
IRC/ORC	inside reactor containment/outside reactor containment
IRWST	in-containment refueling water storage tank
ISI	In-service inspection
ITAA	inspection, test, analysis, and acceptance
IWR(S)	Inter Works Requisition(s)
L/D	length to diameter
LMFBR	liquid metal fast breeder reactor
LMTD	log mean temperature difference
LOCA	loss-of-coolant accident
L/O Dwg	layout drawing
LOE	level of effort
LRB	Licensing Review Basis document
LSPB	large-scale prototype breeder
LWR	light water reactor
LWPS	liquid waste processing system
MACCS	Melcor Accident Consequence Code System
MAPP	Modular Accident Analysis Program
MCB	main control board
MCR	main control room
MCS	management control system
MIC	Management Information Center
MIL-STDS	military standards
MR	management reserve
MTTR	mean time to repair
NATD	Nuclear and Advanced Technology Division (Westinghouse)
NC	numerically controlled
NERVA	nuclear engine for rocket vehicle application
NNS	non-nuclear safety

NPSH	net positive suction head
NQA-1	ANSI/ASME Quality Assurance Standard
NRC	Nuclear Regulatory Commission
NRL	Naval Research Laboratory
NSSS	nuclear steam supply system
NUMARC	Nuclear Utility Management and Resources Council
O&M	operation and maintenance
OBE	operating base earthquake
OCI	organizational conflicts of interest
OFA	optimized fuel assemblies
ORE	occupational radiation exposure
P&ID	piping and instrument drawings
PCCS	passive containment cooling system
PCT	peak clad temperature
PFD	process flow design
PIN	plant information network
PLEX	plant life extension
PLS	precautions, limitations, and setpoints
PMB	project measurement baseline
PMCS	project management control system
PMP	Project Management Plan
PMS	performance measurement system
PMTTS	Project Management Task Tracking System
P.O.	purchase order
PRA	probabilistic risk assessment
PRHR HX	passive residual heat removal heat exchanger
PSAR	Preliminary Safety Analysis Report
PSIS	passive safety injection system
PUC	Public Utility Commission
PWR	pressurized water reactor
PWR IPE	pressurized water reactor individual plant evaluation
QA	quality assurance
QAP	Quality Assurance Plan
QAPP	Quality Assurance Program Plan
QE	Quality Engineering
QF	Qualifying Facility (Under Public Utility Regulatory Policy Act - PURPA)
QRC	Quality Review Committee
RAM	reliability, availability, and maintainability
RBD	reliability block diagram
RC	reactor coolant
RCP	reactor coolant pump
RCS	reactor coolant system
RD&D	research, design & development
RD/GA	research and development/general and administration
RF	radio frequency
RFE	request for estimate
RFP	Request for Proposals
RFQ	Request for Quotations
RHR	residual heat removal
RPV	reactor pressure vessel
RTD	resistance temperature detector
SAR	Safety Analysis Report
SC	supervisory console
SD	system description
SER	Safety Evaluation Report
SF	standard form
SFCS	spent fuel cooling system
SG	steam generator
SGBPS	steam generator blowdown processing system
SGTR	steam generator tube rupture
SIS	safety injection system
SNUPPS	Atandard Nuclear Unit Power Plant Systems
SOW	Statement of Work
SP-100	100 kW Space Reactor Program (DOE)
SPCS	safety passive cooling system
SRP	Savannah River Plant
SSAR/ITAA	Standard Safety Analysis Report / Inspection, Test, Analysis, and Acceptance Criteria
SSE	safe shutdown earthquake
SWPS	solid waste processing center
SYS/DIP	systems/design integration process
TMI	Three Mile Island
TSC	technical support center

TVA	Tennessee Valley Authority
UA	overall heat transfer coefficient x SG area
UB	undistributed budget
URD	Utility Requirements Document
URS	Uniform Reporting System
U.S.	United States
USI	unresolved safety issues
UT	ultrasonic testing
V&V	verification and validation
VAR	variance analysis report
WA	work authorization
WAF	work authorization form
WBS	Work Breakdown Structure
WCAP	Westinghouse Topical Report Prefix
WINCO	Westinghouse Idaho Nuclear Company
WIPP	Waste Isolation Pilot Plant
WP	work package
WPPSS	Washington Public Power Supply Systems
WPS	waste processing system
WRDB	Westinghouse RAM data base
WVDP	West Valley Demonstration Project
ZBCLF	Zero Boron Change Load Follow

1990 Program Work Plan

Section 1 Outline of 1990 Work

The Program Work Plan defines the work activities, resources and schedule to complete the SOW in DOE Contract DE-AC03-90SF18495, without exception. The complete Program Work Plan consists of the Outline of Work (this section), the Work Breakdown Structure (Section 2), The Description of Tasks (Section 3), the Cost Participation by WBS Elements (Section 4), the Program Schedule (Section 5), the Cost Plan (Section 6), and the Labor Plan (Section 7).

The proposed work is organized under the three elements specified and described in the SOW:

- Program Management
- Detailed Design and Development
- Design Certification

These are the level 1 elements of the proposed WBS.

Lines of Investigation

The basic line of investigation that we will pursue in preparing the detailed design of the AP600 plant is illustrated in Figure 1-1. Each of the proposed work activities contributes to progressing the AP600 design from its existing established configuration, through detailed design and the regulatory process, to design certification by December, 1994. The flow of design information is illustrated in the block labeled "Plant Design Activities" in Figure 1-1. For example, as additional design detail is produced for fluid systems and equipment, this information will flow down to all activities below it, permitting additional detail to be developed for those activities. This design process is iterative as the plant design proceeds from conceptual to detailed design level, and is guided by the design drivers and design evaluations as the plant design proceeds. Prior to Standard Safety Analysis Report (SSAR) submittal, the proposed plant design activities will establish the final design information needed for the design certification. After SSAR submittal, the proposed plant design activities will establish additional design information to ensure that procurement and construction design detail is available by mid-1995. The design certification activities illustrated in Figure 1-1 show the progression from establishing the Licensing Review Basis with NRC through to Design Certification.

Method of Approach

To accomplish the required statement of work in an efficient and timely manner, the proposed work plan includes parallel detailed design and design certification activities. This approach is outlined in Table 1-1, which also illustrates the overall phasing and timing incorporated into the work plan.

The completeness of the existing AP600 conceptual design and preliminary safety evaluations provides a solid basis for the parallel approach to detailed design and design certification. The detail design activities proceed in parallel with meaningful design specific discussions with NRC on the licensing review basis and the key licensing issues. The detailed design activities are scheduled to provide the necessary design information for completion of safety analyses, probabilistic risk assessment (PRA), SSAR and Inspection, Test, Analysis and Acceptance Criteria (ITAAC) documentation by June, 1992. Then during NRC/Advisory Committee on Reactor Safeguards (ACRS) review and design certification rulemaking proceedings, the design details for procurement and construction will be prepared. The end result is an NRC certified AP600 plant design, ready for site-specific engineering, procurement, and construction.

Westinghouse and Subcontractor Division of Responsibility

Westinghouse has formed an experienced organization to carry out the proposed work. Table 1-3 specifies the division of responsibility among the AP600 organizations. Each subcontractor, with the

exception of Bechtel North American Power Corporation, and Southern Electric International directly participated in the AP600 Conceptual Design Program and thus, are already part of the functioning Westinghouse AP600 Design Organization that has established the AP600 plant configuration. Westinghouse has selected Bechtel and Southern to participate in detailed design and certification phase on their technical capabilities and resources to perform the specific work activities outlined in Table 1-2.

The division of responsibilities is based on the technical capabilities and resources available from each subcontractor. As prime contractor and design certification applicant, Westinghouse assumes the lead technical and management role, responsible to DOE for all program activities. Each of the subcontractors was selected to perform the work responsibilities as specified in Table 1-2 and described by the task descriptions in Section 3.

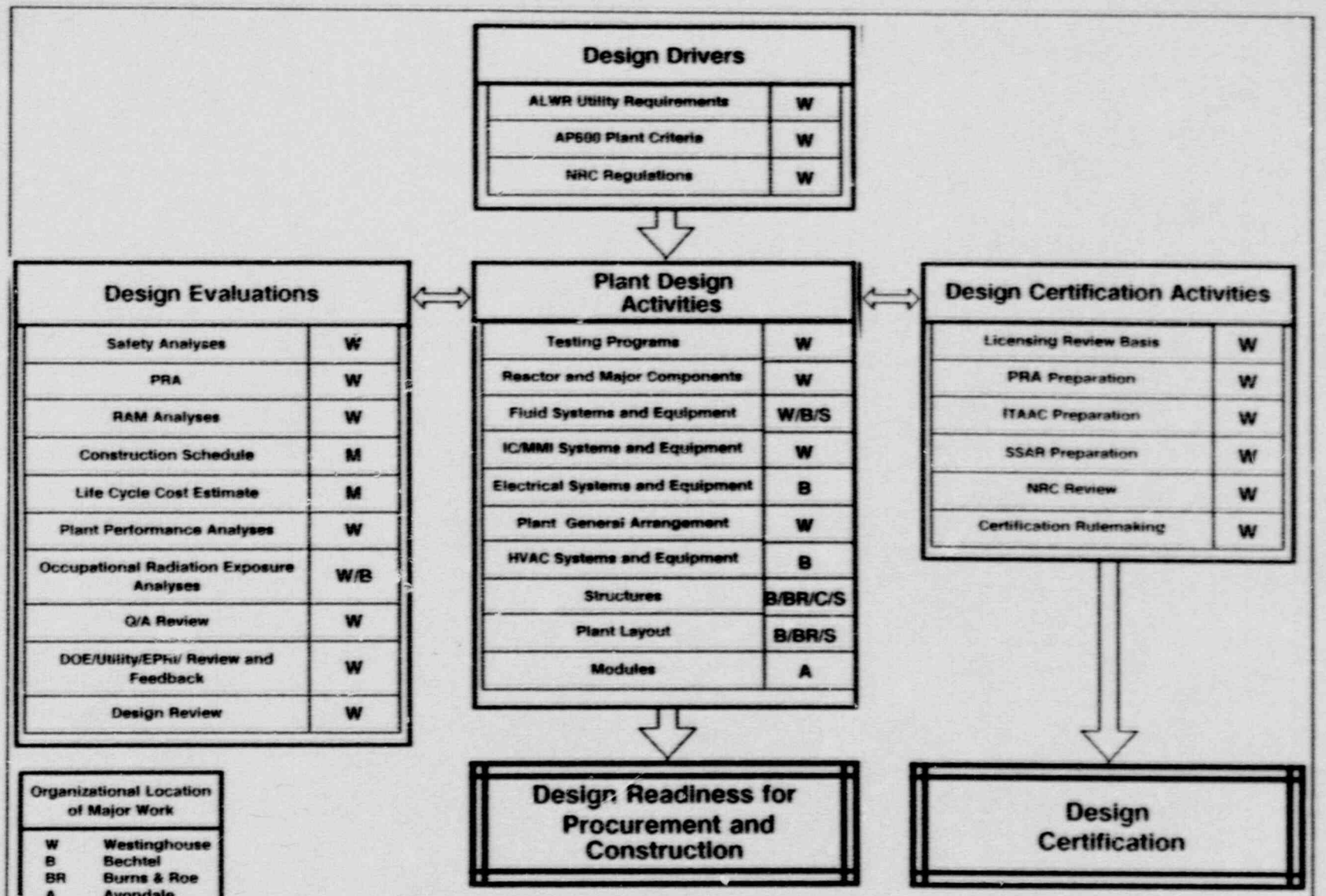


FIGURE 1-1 AP600 BASIC WORK FLOW: Lines of investigation lead to design certification and readiness for procurement and construction.

TABLE 1-1 PARALLEL APPROACH TO ACHIEVE AP600 DESIGN AND NRC CERTIFICATION

Timing	Detailed Design and Development	Design Certification
Start	• AP600 Conceptual Design	• AP600 Preliminary Safety Evaluations
Months 0 to 6	• Finalize Design Criteria • Preliminary Design Data across Discipline Interfaces	• Establish Licensing Review Basis
Months 6 to 15	• Intermediate-level Design Data • Design Reviews and Integration Checks • Complete Safety Systems Tests	• Submit to DOE LRB and Key Licensing Issues Resolution Basis • Initiate SSAR and ITAAC Preparation
Months 15 to 30	• Finalize Design for Certification • Complete Design Verification Testing	• Complete Safety Analyses and PRA • Complete Preparation of SSAR and ITAAC
Months 30 to 48	• Finalize Detailed Design for Procurement and Construction	• Obtain NRC and ACRS Final Design Approval
Months 48 to 66	• Prepare Procurement and Construction Plan Detail	• Complete Design Certification Rulemaking
End of Contract Work	**Design**	**Certification**
Month 60 to 120	• Site-specific Engineering • Procurement • Construction • Operation	• Apply Design Certificaiton for Combined Operating Licensing at a Specific Site

TABLE 1-2 **AP600 WBS PARTICIPATION:** Responsibilities for work areas have been assigned according to organizational expertise.

WBS Element (Level 3)		Westinghouse	Bechtel	Burns & Roe	Avondale	MK-Ferguson	CBI Services	Southern
1.1.1	Quality Assurance Plan	•						
1.1.2	Quality Assurance Programs	•	•	•	•	•	•	•
1.1.3	Quality Assurance Administration	•						
1.2.1	RAM Plan	•						
1.2.2	RAM Program Administration	•						
1.3.1	Configuration Management Plan	•						
1.3.2	Configuration Management Program	•	•	•	•	•	•	•
1.3.3	Configuration Management Program Administration	•						
1.4.1	Program Management Plan	•						
1.4.2	Program Administration and Control	•	•	•	•	•	•	•
1.5.1	Program Review Reports	•						
1.5.2	Design Review Reports	•						
1.5.3	CDRLs and Other DOE Topical Reports	•						
1.5.4	Executive Board Reviews	•						
1.6.1	Subcontract Management Plan	•						
1.6.2	Cost/Schedule Monitoring (subcontractors)	•						
1.6.3	Subcontract Administration	•						
2.1.1	Design Basis Documentation	•						
2.1.2	EPRI ALWR Utility Requirements Document Review	•						
2.1.3	Plant Computer-Aided Engineering Data Base	•						
2.1.4	Design Integration and Configuration	•	•					

TABLE 1-2 (cont) AP600 WBS PARTICIPATION

WBS Element (Level 3)		Westinghouse	Bechtel	Burns & Roe	Avondale	MK-Ferguson	CBI Services	Southern
2.1.5	Reliability, Availability, Maintainability	•	•	•	•	•	•	•
2.2.1	Reactor System	•						
2.2.2	Reactor Coolant System	•						
2.2.3	Reactor Coolant System Major Components	•						
2.2.4	Nuclear Fluid Systems	•						
2.2.5	Steam and Power Conversion Systems	•						•
2.2.6	Auxiliary Fluid Systems	•	•					•
2.2.7	Main Control Room, Emergency Control Room, Technical Support Center	•						
2.2.8	Instrumentation and Control Systems	•						
2.2.9	Electrical Systems		•	•				
2.2.10	Heating, Ventilation, Airconditioning Systems		•	•				
2.2.11	Radioactive Waste Treatment Systems	•	•	•				•
2.2.12	Mechanical Handling Systems	•	•					
2.2.13	Water and Waste Treatment Systems	•						•
2.3.1	General Arrangement	•						
2.3.2	Plant Design - Nuclear Island		•					
2.3.3	Modularization				•			
2.3.4	Architectural Features		•					
2.3.5	Site Envelope	•	•					
2.3.6	First Unit Project Plan and Schedule	•				•		
2.3.7	Construction Plan and Schedule					•		
2.3.8	Construction Methods					•		
2.3.9	Capital Cost Estimate					•		

TABLE 1-2 (cont) AP600 WBS PARTICIPATION

WBS Element (Level 3)		Westinghouse	Bechtel	Burns & Roe	Avondale	MK-Ferguson	CBI Services	Southern
2.3.10	Plant Design - Turbine Island							•
2.3.11	Plant Design - Annex			•				
2.3.12	Solid Radwaste			•				
2.3.13	C.W. Pump House & Cooling Tower							•
2.3.14	Plant Design - Misc. Buildings							•
2.4.3	Seismic Analysis		•					
2.4.4	Nuclear Island Structures		•					
2.4.5	Containment Vessel						•	
2.4.6	Turbine Island Structures							•
2.4.7	Annex Building Structures			•				
2.4.8	Solid Radwaste Building Structures			•				
2.4.11	Circulating Water Pump House Structure							•
2.4.12	Miscellaneous Structures	•						•
2.5.1	Protection System Functional Analysis and Requirements	•						
2.5.2	Control System Functional Analysis and Requirements	•						
2.5.3	Reactor Coolant System Design Transients Analysis	•						
2.5.4	Shielding and Radiation Analysis	•	•					
2.5.5	Hazards Analyses	•	•					
2.5.6	Emergency Operating Procedures	•						
2.6.1	Reactor Coolant Pump Flow Test	•						
2.6.2	Thermal Hydraulic Reactor Vessel Internals Test	•						

TABLE 1-2 (cont) AP600 WBS PARTICIPATION

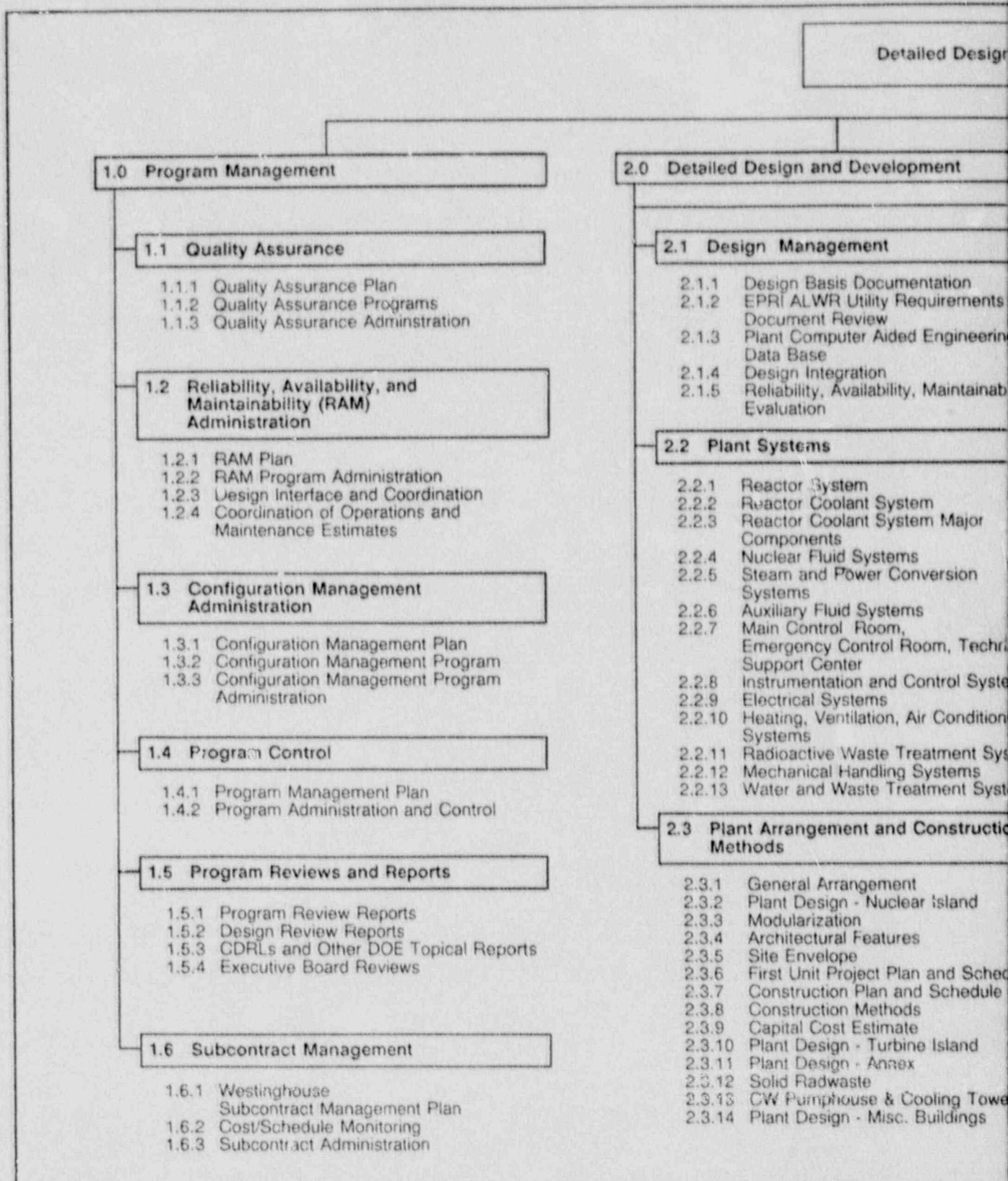
WBS Element (Level 3)		Westinghouse	Bechtel	Burns & Roe	Avondale	MK-Ferguson	CBI Services	Southern
2.6.3	Incore Instrumentation Tests	•						
2.6.4	Departure from Nucleate Boiling (DNB) Test	•						
2.6.5	Passive Containment Cooling System Water Distribution Test	•						
2.6.6	Passive Containment Cooling System Heat Transfer Test	•						
2.6.7	Passive Containment Cooling System Wind Tunnel Test	•						
2.6.8	Long-Term Cooling Test	•						
2.6.9	Automatic Depressurization System Hydraulic Test	•						
2.6.10	Component Tests	•						
2.6.11	Baseline Tests	•						
3.1.1	Design Basis Accident Analysis	•						
3.1.2	Probabilistic Risk Assessment	•						
3.1.3	Licensing Basis Commitment Management	•						
3.2.1	Licensing Review Basis Documentation	•	•					
3.2.2	Key Licensing Issues Review	•	•					
3.2.3	Standard Safety Analyses Report	•	•	•	•	•	•	•
3.2.4	Probabilistic Risk Assessment Documentation	•						•
3.2.5	Inspections, Tests, Analysis, and Acceptance Criteria Document	•	•	•	•	•	•	•
3.3.1	Question and Comment Resolution	•	•	•	•	•	•	•

TABLE 1-2 (cont) AP600 WBS PARTICIPATION

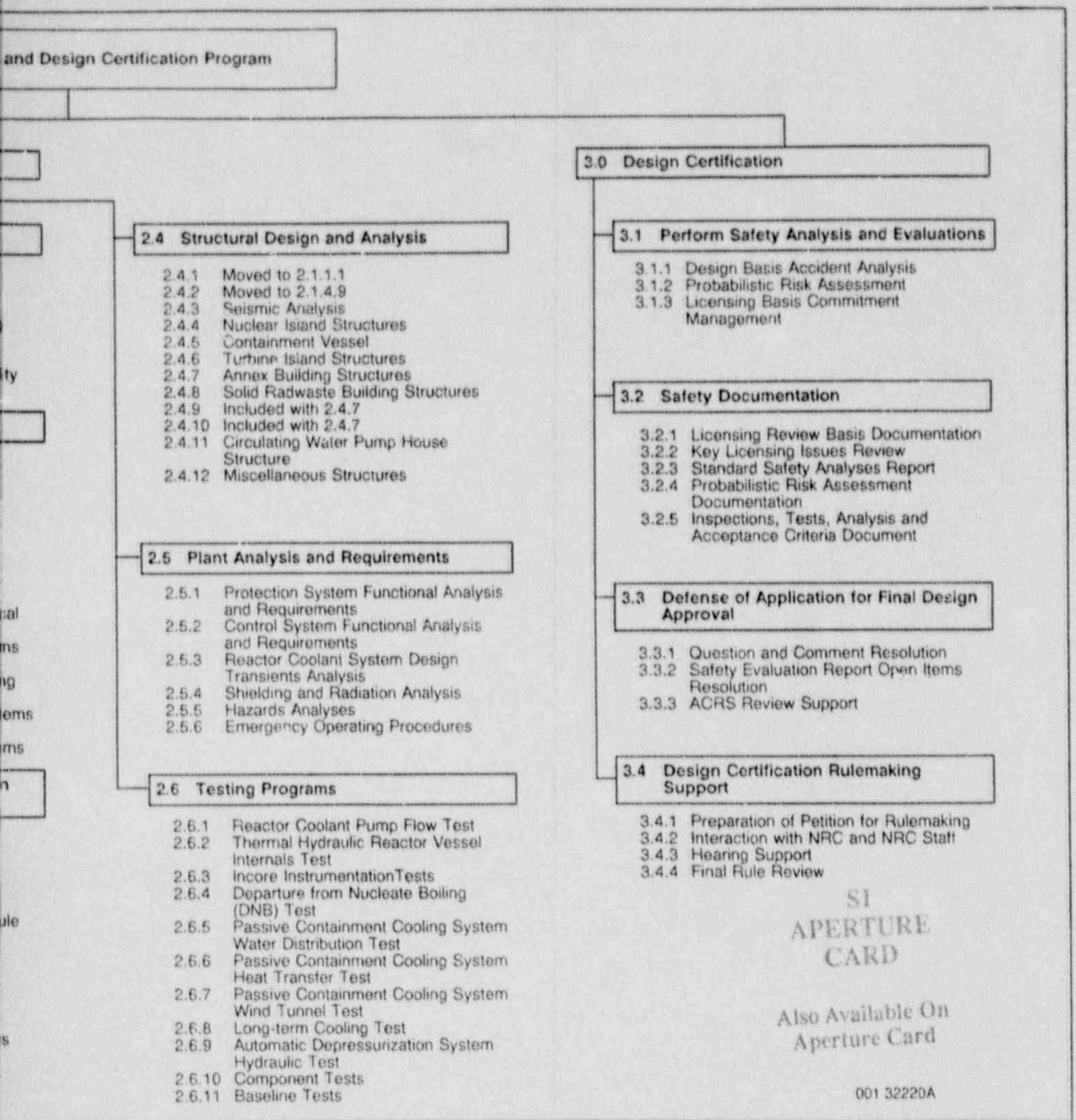
WBS Element (Level 3)		Westinghouse	Bechtel	Burns & Roe	Avondale	MK-Ferguson	CBI Services	Southern
3.3.2	Safety Evaluation Report Open Items Resolution	•	•	•	•	•	•	•
3.3.3	ACRS Review Support	•	•	•	•	•	•	•
3.4.1	Preparation of Petition for Rulemaking	•						
3.4.2	Interaction With NRC and NRC Staff	•	•					
3.4.3	Hearing Support	•	•					
3.4.4	Final Rule Review	•						

1990 Program Work Plan

Work Breakdown Structure (WBS) 2



Our WBS addresses all AP600 hardware, software, design, and licensing needs and provides easy recognition o



DOE tasks.

FIGURE 2.1 AP600 WORK BREAKDOWN STRUCTURE

U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY
PART I - INDEX

DOE F1332.10
(11-84)

1. PROJECT TITLE PARTICIPANT	2. DATE	3. IDENTIFICATION NUMBER
AP600 / Westinghouse	2-27-90	DE-AC03-90SF18495

4. LINE NO.	5. WBS ELEMENTS										6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET AND REPORTING Number	8. PHASE	9. OTHER
	INDENTURE LEVEL									TITLE				
	1	2	3	4	5	6	-	-	-					
1	x									PROGRAM MANAGEMENT	1.0			
2										Quality Assurance	1.1			
3			x							Quality Assurance Plan	1.1.1			
4			x							Quality Assurance Programs	1.1.2			
5			x							Quality Assurance Administration	1.1.3			
6		x								Reliability, Availability, and Maintainability (RAM) Administration	1.2			
7			x							RAM Plan	1.2.1			
8			x							RAM Program Administration	1.2.2			
9			x							Design Interface and Coordination	1.2.3			
10			x							Coordination of Operation and Maintenance	1.2.4			
11		x								Configuration Management Administration	1.3			
12			x							Configuration Management Plan	1.3.1			
13			x							Configuration Management Program	1.3.2			
14			x							Configuration Management Program Administration	1.3.3			
15		x								Program Control	1.4			
16			x							Program Management Plan	1.4.1			
17			x							Program Administration and Control	1.4.2			
18		x								Program Reviews and Reports	1.5			
19			x							Program Review Reports	1.5.1			

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WORK BREAKDOWN STRUCTURE DICTIONARY
PART I - INDEX

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(11-84)

1. PROJECT TITLE PARTICIPANT	2. DATE	3. IDENTIFICATION NUMBER
AP600 / Westinghouse	2-27-90	DE-AC03-90SF18495

4. LINE NO.	5. WBS ELEMENTS — INDENTURE LEVEL 1	2	3	4	5	6	-	-	-	TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET AND REPORTING Number	8. PHASE	9. OTHER
20			x							Design Review Reports	1.5.2			
21			x							CDRLs and Other DOE Topical Reports	1.5.3			
22			x							Executive Board Reviews	1.5.4			
23		x								Subcontract Management	1.6			
24			x							Subcontract Management Plan	1.6.1			
25			x							Cost/Schedule Monitoring (subcontractors)	1.6.2			
26			x							Subcontract Administration	1.6.3			
27	x									DETAIL DESIGN AND DEVELOPMENT	2.0			
28		x								Design Management	2.1			
29			x							Design Basis Documentation	2.1.1			
30			x							EPRI ALWR Utility Requirements Document Review	2.1.2			
31			x							Plant Computer-Aided Engineering Data Base	2.1.3			
32			x							Design Integration and Configuration	2.1.4			
33			x							Reliability, Availability, Maintainability	2.1.5			
34		x								Plant Systems	2.2			
35			x							Reactor System	2.2.1			
36			x							Reactor Coolant System	2.2.2			
37			x							Reactor Coolant System Major Components	2.2.3			

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1. PROJECT TITLE PARTICIPANT	2. DATE	3. IDENTIFICATION NUMBER
AP600 / Westinghouse	2-27-90	DE-AC03-90SF18495

4. LINE NO.	5. WBS ELEMENTS: INDENTURE LEVEL 1	2	3	4	5	6	-	-	-	TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET AND REPORTING Number	8. PHASE	9. OTHER
38			x							Nuclear Fluid Systems	2.2.4			
39			x							Steam and Power Conversion Systems	2.2.5			
40			x							Auxiliary Fluid Systems	2.2.6			
41			x							Main Control Room, Emergency Control Room, Technical Support Center	2.2.7			
42			x							Instrumentation and Control Systems	2.2.8			
43			x							Electrical Systems	2.2.9			
44			x							Heating, Ventilation, Air-conditioning Systems	2.2.10			
45			x							Radioactive Waste Treatment Systems	2.2.11			
46			x							Mechanical Handling Systems	2.2.12			
47			x							Water and Waste Treatment System	2.2.13			
48		x								Plant Arrangement and Construction Methods	2.3			
49			x							General Arrangement	2.3.1			
50			x							Plant Design - Nuclear Island	2.3.2			
51			x							Modularization	2.3.3			
52			x							Architectural Features	2.3.4			
53			x							Site Envelope	2.3.5			
54			x							First Unit Project Plan and Schedule	2.3.6			
55			x							Construction Plan and Schedule	2.3.7			
56			x							Construction Methods	2.3.8			

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57			x							Capital Cost Estimate	2.3.9			
58			x							Plant Design - Turbine Island	2.3.10			
59			x							Plant Design - Annex Building	2.3.11			
60			x							Plant Design - Solid Radwaste Building	2.3.12			
61			x							Plant Design - Circulating Water Pumphouse and Cooling Towers	2.3.13			
62			x							Plant Design - Miscellaneous Building	2.3.14			
63		x								Structural Design and Analysis	2.4			
64			x							Structural Design Criteria	2.4.1			
65			x							General Construction Specifications	2.4.2			
66			x							Seismic Analysis	2.4.3			
67			x							Nuclear Island Structures	2.4.4			
68			x							Containment Vessel	2.4.5			
69			x							Turbine Island Structures	2.4.6			
70			x							Annex Building Structures	2.4.7			
71			x							Solid Radwaste Building Structures	2.4.8			
72			x							Diesel Generator Building Structures (Included in 2.4.7)	2.4.9			
73			x							Access Control Building Structures (Included in 2.4.7)	2.4.10			
74			x							Circulating Water Pump House Structure	2.4.11			

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4. LINE NO.	5. WBS ELEMENTS — INDENTURE LEVEL 1	2	3	4	5	6	-	-	-	TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET AND REPORTING Number	8. PHASE	9. OTHER
75			x							Miscellaneous Structures	2.4.12			
76		x								Plant Analysis	2.5			
77			x							Protection System Functional Analysis and Requirements	2.5.1			
78			x							Control System Functional Analysis and Requirements	2.5.2			
79			x							Reactor Coolant System Design Transients Analysis	2.5.3			
80			x							Shielding and Radiation Analysis	2.5.4			
81			x							Hazards Analyses	2.5.5			
82			x							Emergency Operating Procedures	2.5.6			
83		x								Testing Programs	2.6			
84			x							Reactor Coolant Pump Flow Test	2.6.1			
85			x							Thermal Hydraulic Reactor Vessel Internals Test	2.6.2			
86			x							Incore Instrumentation Test	2.6.3			
87			x							Departure From Nucleate Boiling Test	2.6.4			
88			x							Passive Containment Cooling System Water Distribution Test	2.6.5			
89			x							Passive Containment Cooling System Heat Transfer Test	2.6.6			
90			x							Passive Containment Cooling System Wind Tunnel Test	2.6.7			
91			x							Long-Term Cooling Test	2.6.8			
92			x							Automatic Depressurization System Hydraulic Test	2.6.9			

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4. LINE NO.	5. WBS ELEMENTS: INDENTURE LEVEL 1	2	3	4	5	6	-	-	-	TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET AND REPORTING Number	8. PHASE	9. OTHER
93			x							Component Tests	2.6.10			
94			x							Development Test Extensions	2.6.11			
95	x									DESIGN CERTIFICATION	3.0			
96		x								Safety Analysis and Evaluations	3.1			
97			x							Design Basis Accident Analysis	3.1.1			
98			x							Probabilistic Risk Assessment	3.1.2			
99			x							Licensing Basis Commitment Management	3.1.3			
100		x								Safety Documentation	3.2			
101			x							Licensing Review Basis Documentation	3.2.1			
102			x							Key Licensing Issues Review	3.2.2			
103			x							Standard Safety Analyses Report	3.2.3			
104			x							Probabilistic Risk Assessment Documentation	3.2.4			
105			x							Inspections, Tests, Analysis, and Acceptance Criteria Document	3.2.5			
106		x								Defense of Application for Final Design Approval	3.3			
107			x							Question and Comment Resolution	3.3.1			
108			x							Safety Evaluation Report Open Items Resolution	3.3.2			
109			x							ACRS Review Support	3.3.3			

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4. LINE NO.	5. WBS ELEMENTS										6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET AND REPORTING Number	8. PHASE	9. OTHER
	INDENTURE LEVEL									TITLE				
	1	2	3	4	5	6	-	-	-					
110		x								Design Certification Rulemaking Support	3.4			
111			x							Preparation of Petition for Rulemaking	3.4.1			
112			x							Interaction with NRC and NRC Staff	3.4.2			
113			x							Hearing Support	3.4.3			
114			x							Final Rule Review	3.4.4			

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1. PROJECT TITLE/PARTICIPANT	2. DATE	3. IDENTIFICATION NUMBER
AP600/Westinghouse	2-27-90	DE-AC03-90SF18495

4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
1.1	Quality Assurance

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
2		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

Work breakdown structure element 1.1 requires the following WBS elements to be completed, available or ongoing:

1.1.1 Quality Assurance Plan
1.1.2 Quality Assurance Programs
1.1.3 Quality Assurance Administration

c) Work Statement

Develop and submit to DOE a Quality Assurance Plan within (CDRL No. 16) 60 days after contract award. Administer program which implements requirements of ANSI/ASME NQA-1 "Quality Assurance Program Requirements for Nuclear Facilities." Perform internal and supplier audit and surveillance. Perform records management.

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1. PROJECT TITLE/PARTICIPANT	2. DATE	3. IDENTIFICATION NUMBER
AP600/Westinghouse	2-27-90	DE-AC03-90SF18495

4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
1.2	Reliability, Availability and Maintainability (RAM) Administration

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
6		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

Work breakdown structure element 1.2 requires the following WBS elements to be completed, available or ongoing:

1.2.1 RAM Plan
1.2.2 RAM Program Administration
1.2.3 Design Interface and Coordination
1.2.4 Coordination of Operations and Maintenance

c) Work Statement

Develop and submit to DOE AP600 RAM Plan within (CDRL No. 15) 60 days after contract award. Administer the plan which establishes, implements and maintains program in accordance with MIL-STD-785B, MIL-STD-470A and Appendix A of each MIL-STDS.

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1. PROJECT TITLE/PARTICIPANT	2. DATE	3. IDENTIFICATION NUMBER
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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
1.3	Configuration Management Administration

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
11		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

Work breakdown structure element 1.3 requires the following WBS elements to be completed, available or ongoing:

1.3.1 Configuration Management Plan
1.3.2 Configuration Management Program
1.3.3 Configuration Management Program Administration

c) Work Statement

Develop and submit to DOE Configuration Management Plan (CDRL No. 14) within 60 days after contract award. Administer program which provides programmatic control to ensure that a formal review and approval process is maintained for changes to technical, schedule, and cost baselines.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
1.4	Program Control

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
15		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

Work breakdown structure element 1.4 requires the following WBS elements to be completed, available or ongoing:

1.4.1 Program Management Plan
1.4.2 Program Administration and Control

c) Work Statement

Develop and submit to DOE AP600 Program Management Plan within 60 days after contract award. Administer program which provides the methods and procedures used to collect and integrate the cost, schedule, and technical information. Comply with DOE Uniform Reporting System (URS) Guidelines and DOE 4700.1. Prepare detailed schedules and budgets, provide project status, identify potential problem areas. Report project performance information to DOE monthly.

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AP600/Westinghouse	2-27-90	DE-AC03-90SF18495

4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
1.5	Program Reviews and Reports

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
18		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

Work breakdown structure element 1.5 requires the following WBS elements to be completed, available or ongoing :

1.5.1 Program Reviews and Reports
1.5.2 Design Review Reports
1.5.3 CDRLs and other DOE Topical Reports
1.5.4 Executive Board Reviews.

c) Work Statement

Prepare and submit to DOE and project participants program review reports which summarize technical progress, current design status and program cost status within 30 days after the semi-annual design review. Prepare and submit to DOE design reviews (CDRL No. 7) that summarize activities and findings associated with AP600 principal design review within 30 days after design review. Prepare and issue to DOE plans, lists documents and reports identified in DOE's Contract Data Requirements List (CDRL) specifications. Prepare reports from Executive Board Reviews as appropriate.

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1. PROJECT TITLE/PARTICIPANT AP600/Westinghouse	2. DATE 2-27-90	3. IDENTIFICATION NUMBER DE-AC03-90SF18495
4. WBS ELEMENT CODE 1.6	5. WBS ELEMENT TITLE Subcontract Management	
6. INDEX LINE NUMBER 23	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
9. APPROVED CHANGES		
10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER	

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material
Computer Usage
Subcontracted Effort
Overhead
Cost of Money
G&A

b) Technical Content

Work breakdown structure element 1.6 requires the following WBS elements to be available or ongoing:

1.6.1 Subcontract Management Plan
1.6.2 Cost/Schedule Monitoring (subcontractors)
1.6.3 Subcontract Administration.

c) Work Statement

Identify cost and schedule baselines of subcontractors and measure performance to ensure that the work of all subcontractors is integrated into the work effort in accordance with PL 95-9507. Monitor subcontractor activity to ensure that overall management control criteria are met. Administer plan which involves review and demonstration of all elements of the subcontract work scope.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
2.1	Design Management

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
28		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 2.1 requires the following WBS elements to be completed and available:

2.1.1 Design Basis Documentation
2.1.2 EPRI ALWR Utility Requirements Document Review
2.1.3 Plant Computer-Aided Engineering/Data Base
2.1.4 Design Integration
2.1.5 Reliability, Availability, Maintainability

c) Work Statement

Prepare and revise Design Basis Documents (CDRL No. 1, 2, 3, 4, 5, 6, 7, 8). Conduct review of EPRI ALWR Utility Requirements and prepare evaluation reports. Establish and maintain plant CAE data base including configuration control. Perform plant-level design integration checks. Perform RAM evaluations to guide detailed design.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
2.2	Plant Systems

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
34		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 2.2 requires the following WBS elements to be completed and available:

2.2.1 Reactor System
2.2.2 Reactor Coolant System
2.2.3 Reactor Coolant System Major Components
2.2.4 Nuclear Fluid Systems
2.2.5 Steam and Power Conversion Systems
2.2.6 Auxiliary Fluid Systems
2.2.7 Main Control Room Emergency Control Room, Technical Support Center
2.2.8 Instrumentation and Control Systems
2.2.9 Electrical Systems
2.2.10 Heating, Ventilation, Air Conditioning Systems
2.2.11 Radioactive Waste Treatment Systems
2.2.12 Mechanical Handling Systems
2.2.13 Water and Waste Treatment Systems

c) Work Statement

Develop design requirements, drawings, analysis, descriptions and specifications for the reactor, core, reactor coolant system and major components, plant fluid systems and equipment, control rooms, I&C systems, electrical systems, HVAC systems, and mechanical handling systems.

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AP600/Westinghouse	2-27-90	DE-AC03-90SF18495

4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
2.3	Plant Arrangement and Construction Methods

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
48		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 2.3 requires the following WBS elements to be completed and available:

2.3.1 General Arrangement
2.3.2 Plant Design - Nuclear Island
2.3.3 Modularization
2.3.4 Architectural Features
2.3.5 Site Envelope
2.3.6 First Unit Project Plan and Schedule
2.3.7 Construction Plan and Schedule
2.3.8 Construction Methods
2.3.9 Capital Cost Estimate
2.3.10 Plant Design - Turbine Island
2.3.11 Plant Design - Annex Building
2.3.12 Plant Design - Solid Radwaste Building
2.3.13 Plant Design - Circulating Water Pumphouse and Cooling Towers
2.3.14 Plant Design - Miscellaneous Building

c) Work Statement

Develop G&A drawings. Develop layout routing of piping, HVAC duct and cable tray. Perform piping and supports analyses. Develop module requirements, analysis, specifications and fabrication methods. Develop plant architectural features specifications and drawings. Prepare site envelope design parameters. Develop first unit project plan/schedule and construction plan/schedule (CDRL No. 12). Develop plant construction methods. Prepare plant capital cost estimate (CDRL No. 13).

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
2.4	Structural Design and Analysis

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
63		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 2.4 requires the following WBS elements to be completed and available:

2.4.1 Structural Design Criteria
2.4.2 General Construction Specifications
2.4.3 Seismic Analysis
2.4.4 Nuclear Island Structures
2.4.5 Containment Vessel
2.4.6 Turbine Island Structures
2.4.7 Annex Building Structures
2.4.8 Solid Radwaste Building Structures
2.4.9 Diesel Generator Building Structures (Included in 2.4.7)
2.4.10 Access Control Building Structures (Included in 2.4.7)
2.4.11 Circulating Water Pump House Structure
2.4.12 Miscellaneous Structures

c) Work Statement

Develop requirements, analysis, specifications and drawings for plant structures.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
2.5	Plant Analysis

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
76		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 2.5 requires the following WBS elements to be completed and available:

2.5.1 Protection System Functional Analysis and Requirements
2.5.2 Control System Functional Analysis and Requirements
2.5.3 Reactor Coolant System Design Transients Analysis
2.5.4 Shielding and Radiation Analysis
2.5.5 Hazards Analyses
2.5.6 Emergency Operating Procedures

c) Work Statement

Perform plant-level analyses to establish protection and control systems functional requirements, reactor coolant system design transients, radiation environments and shielding requirements, design capability to withstand natural and plant internal hazards and prepare emergency operating guidelines.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
2.6	Testing Programs

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
83		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 2.6 requires the following WBS elements to be completed and available:

2.6.1 Reactor Coolant Pump Flow Test
2.6.2 Thermal Hydraulic Reactor Vessel Internals Test
2.6.3 Incore Instrumentation Test
2.6.4 Departure from Nucleate Boiling (DNB) Test
2.6.5 Passive Containment Cooling System Water Distribution Test
2.6.6 Passive Containment Cooling System Heat Transfer Test
2.6.7 Passive Containment Cooling System Wind Tunnel Test
2.6.8 Long-term Cooling Test
2.6.9 Automatic Depressurization System Hydraulic Test
2.6.10 Component Tests
2.6.11 Development Test Extensions

c) Work Statement

For each test: develop requirements, plan, design and fabrication documents. Fabricate test facility and conduct tests. Analyze test results and prepare test report.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
3.1	Perform Safety Analysis and Evaluations

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
96		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 3.1 requires the following WBS elements to be completed and available:

3.1.1 Design Basis Accident Analysis
3.1.2 Probabilistic Risk Assessment
3.1.3 Licensing Basis Commitment Management

c) Work Statement

Perform design basis accident analyses for all accidents required for SSAR. Perform Level 1, 2 and 3 PRA analyses. Establish and maintain a baseline of plant licensing requirements throughout the program.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
3.2	Safety Documentation

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
100		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 3.2 requires the following WBS elements to be completed and available:

3.2.1 Licensing Review Basis Documentation
3.2.2 Key Licensing Issues Review
3.2.3 Standard Safety Analyses Report
3.2.4 Probabilistic Risk Assessment Documentation
3.2.5 Inspections, Tests, Analysis and Acceptance Criteria Document

c) Work Statement

Prepare Licensing Review Basis document (CDRL No. 11) and obtain NRC agreement. Prepare resolution bases for key licensing issues and obtain NRC agreements. Prepare the SSAR (CDRLNo. 9) and submit to NRC. Prepare PRA (CDRL No. 10) documentation and submit to NRC with or in the SSAR. Prepare ITAA document and submit to NRC with SSAR.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
3.3	Defense of Application for Final Design Approval

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
106		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 3.3 requires the following WBS elements to be completed and available:

3.3.1 Question and Comment Resolution
3.3.2 Safety Evaluation Report Open Items Resolution
3.3.3 ACRS Review Support

c) Work Statement

Provide additional information to NRC as required to support NRC review of the SSAR, PRA, and ITAA documentation. Respond to NRC questions. Provide resolution bases for NRC open items and obtain NRC agreements. Attend ACRS review meetings and provide information as required to support ACRS review.

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4. WBS ELEMENT CODE	5. WBS ELEMENT TITLE
3.4	Defense of Application for Final Design Approval

6. INDEX LINE NUMBER	7. REVISION NUMBER AND AUTHORIZATION	8. DATE
110		

9. APPROVED CHANGES

10. SYSTEM DESIGN DESCRIPTION	11. BUDGET AND REPORTING NUMBER

12. ELEMENT TASK DESCRIPTION

a) Cost Content

Direct Labor
Purchased Material and Service
Computer Usage
Travel and Living
Overhead
Cost of Money
G&A

b) Technical Content

WBS Element 3.4 requires the following WBS elements to be completed and available:

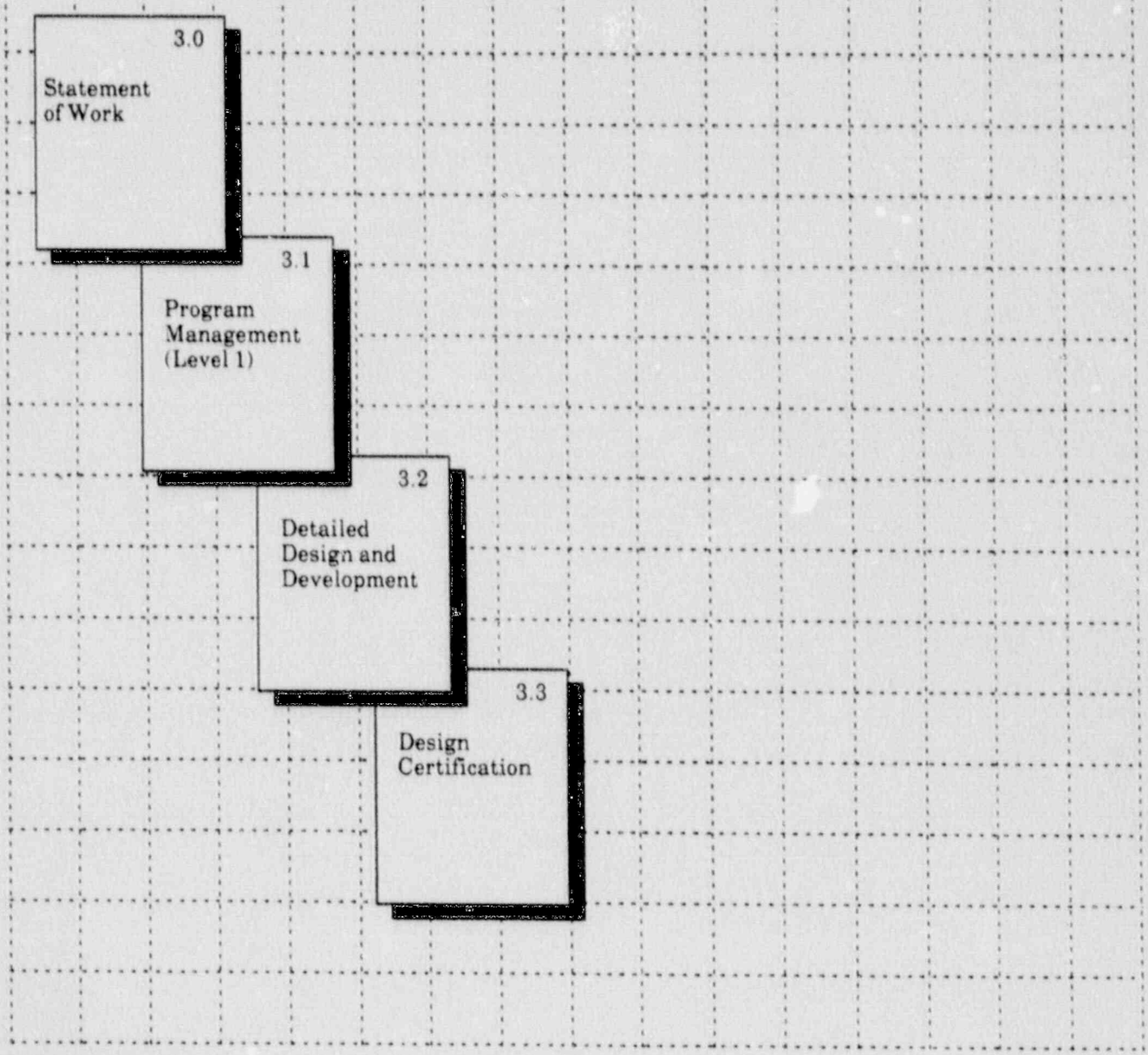
3.4.1 Preparation of Petition for Rulemaking
3.4.2 Interaction with NRC and NRC Staff
3.4.3 Hearing Support
3.4.4 Final Rule Review

c) Work Statement

Develop and present application for Design Certification Rulemaking to NRC. Conduct meetings and discussions with NRC and NRC staff to support the rulemaking process. Provide technical and legal support for the hearing process. Conduct a review of the final rule.

1990 Program Work Plan

Description of Tasks 3



Section 3 Description of Tasks

3.0 STATEMENT OF WORK

(Contract Attachment I)

Westinghouse's scope of work encompasses the engineering, management and execution of the detailed design, and design certification of a simplified, passive, advanced light water reactor plant of 600 MWe nominal output power rating (hereafter known as AP600).

The scope of work encompasses the AP600 plant consisting of a Nuclear Island and the associated balance of plant scope. The design certification effort for the AP600 will obtain NRC final design approval and design certification for the AP600 under the NRC Standard Plant Licensing Policy. The final product will be an NRC certified AP600 plant design, ready for site-specific engineering, procurement and construction.

The task descriptions that follow provide a brief summary of the work to be performed by Westinghouse under this contract. The work is organized into three specific Work Breakdown Structure (WBS) elements: 1.0 Program Management, 2.0 Detailed Design and Development, and 3.0 Design Certification.

Additional details concerning the work scope to be performed can be found in the AP600 Program Work Plan and WBS.

1.0 Program Management

The objective of the AP600 Program Management effort is to provide quality assurance, RAM administration, configuration management, program control and subcontract management programs that comply with DOE requirements, including ANSI/ASME NQA-1, MIL-STD-785B and DOE/MA-0203. The effort involves preparing and submitting to DOE the following plans/documents: 1) Quality Assurance Plan, 2) RAM Plan, 3) Configuration Management Plan, 4) Program Management Plan, and 5) Subcontractor Management Plan. These plans describe the procedures to be taken to develop cost, schedule and technical baselines, monitor and report project performance, monitor subcontractor performance and ensure baseline integrity through rigorous change control processes.

The program management effort is comprised of the following Level 2 elements:

1.1 Quality Assurance
1.2 Reliability, Availability and Maintainability RAM Administration
1.3 Configuration Management Administration
1.4 Program Control
1.5 Program Reviews and Reports
1.6 Subcontract Management

2.0 Detailed Design and Development

The objective of the Detailed Design and Development effort is to complete the detailed design and development of the AP600 Simplified Passive ALWR Plant. The effort involves preparing and revising Design Basis Documents; establishing and maintaining the plant CAE data base; and performing RAM evaluations to guide the detailed design effort. The AP600 plant design will be evaluated for compliance with the EPRI ALWR utility passive plant requirements document as they become available from EPRI.

Westinghouse will develop design requirements, drawings, analysis, descriptions and specifications for the reactor, core, reactor coolant system and major components, plant fluid systems and equipment, control rooms,

I&C systems, electrical systems, HVAC systems and mechanical handling systems.

Westinghouse will develop G&A drawings, develop layout routing of piping, HVAC duct and cable tray; perform piping and supports analysis. Module requirements, analysis, specifications, and fabrication methods will be developed. Plant construction methods and a capital cost estimate will be prepared. All requirements, analysis, specifications and drawings will be developed for AP600 plant structures.

Plant-level analysis for protection and control systems functional requirements, design transients, and shielding requirements will be performed. Emergency operating guidelines will be prepared. Testing requirements and plans will be developed for each proposed AP600 test. Test facilities will be fabricated, and tests including various component and baseline tests, will be performed to verify/confirm detailed design. Test reports will be prepared and issued.

The Detailed Design and Development effort is comprised of the following Level 2 elements:

2.1 Design Management
2.2 Plant Systems
2.3 Plant Arrangement and Construction Methods
2.4 Structural Design and Analysis
2.5 Plant Analysis
2.6 Testing Programs

3.0 Design Certification

The objective of the design certification effort is to obtain NRC Final Design Approval and Design Certification for the detailed plant design under NRC Standard Plant Licensing Policy. This effort involves performing design basis accident analysis for all accidents required for SSAR; performing Level 1, 2 and 3 PRA analysis; and establishing and maintaining a baseline of plant licensing requirements throughout the life of the AP600 Program.

Westinghouse will prepare a Licensing Review Basis Document, and obtain NRC agreement. In addition, the SSAR, PRA, and ITAA will be prepared and submitted to the NRC. Additional information will be prepared and provided to the NRC as required to support review of the SSAR, PRA and ITAA, and to support ACRS review.

Westinghouse will develop and present application for design certification rulemaking to NRC, and will provide all necessary support for the rulemaking/hearing process.

The Design Certification effort is comprised of the following Level 2 WBS elements:

3.1 Perform Safety Analysis and Evaluations
3.2 Safety Documentation
3.3 Defense of Application for Final Design Approval
3.4 Design Certification Rulemaking Support

Technical Documentation

Westinghouse will provide technical documentation in accordance with the following:

a. Preparation and delivery of all plans, lists, and documents identified in the Contract Data Requirements List (CDRL) (Attachment VII) as specified in the CDRL.

b. Based on the information contained in the System Design Description List, Design Drawings List, Design Specifications List, Safety Analyses List, and Miscellaneous Technical Documents and Drawings List, DOE and Westinghouse will jointly decide which

specific documents and drawings to add to the CDRL as deliverables.

c. Based on the information contained in the Design Review List, DOE and Westinghouse will jointly decide which Design Review Reports will be added to the CDRL's deliverables. Design review reports will be delivered to DOE for information not more than 30 days after the review is conducted.

d. Preparation and delivery of all plans and reports identified in the Reporting Requirements Checklist (Attachment II) as specified in the checklist.

e. Any data identified for delivery to DOE in the above paragraphs, which is also defined as limited rights data or copyrighted data not first produced in the performance of this contract shall be furnished in accordance with the provisions stipulated in Clauses I.102(n) and I.047.

f. Requests for such limited rights and/or copyrighted data shall be honored from the Contracting Officer, the DOE Project Manager, or the DOE Program Manager, as identified in Clauses G.002, paragraph (d) and G.003, paragraphs (a) and (b).

g. The following is a list of subject matter headings which the Contractor asserts may contain limited rights data and/or copyrighted data and which may be delivered in accordance with the provisions stipulated in FAR 52.227-14, "Rights in Data - General" as set forth in Clauses I.047 and I.102(n), subparagraph (g)(2).

1) Specific Design Documents, design specifications, and Drawings which identify proprietary material designs, dimensions, tolerances, etc.

2) Individual System Descriptions which describe proprietary processes, component features, or specifications. Generally this information would be beyond SSAR level of detail.

3) Detailed Design Requirements and Design Parameters (e g Drawings) beyond SSAR level of detail.

4) Construction Plan which contains Westinghouse/subcontractor proprietary techniques.

5) Cost Estimates which disclose Westinghouse/subcontractor proprietary cost elements.

The following notes apply to this list:

(i) Documents delivered that are encompassed by this list shall be added to the Contracts Data Requirements List (CDRL), Attachment VII. The item shall be marked with an asterisk next to it, in order to denote that it contains limited rights data and/or copyright data. This list will be updated on a periodic basis and may be incorporated as part of the contract at DOE's unilateral option.

(ii) DOE reserves the right to require the contractor to substantiate the propriety of any applied markings in accordance with Clause I.102(n) paragraph (e).

3.1 PROGRAM MANAGEMENT

Program management activities are organized into six level 2 elements – quality assurance, reliability, availability and maintainability, configuration management, program control, program reviews and subcontract management.

WBS Element 1.1 Quality Assurance

Purpose

Quality Assurance comprises all those planned and systematic actions necessary to provide adequate confidence that the Detailed Design and Design Certification Program is accomplished correctly and in compliance with the governing requirements.

Provided below in the quality assurance (QA) WBS is a brief description of the QA activities for the AP600 Detailed Design and Design Certification Program. This structure provides a description of the elements and work activities necessary to plan, direct, and control quality functions of Westinghouse and suppliers.

Approach

Within 60 days after contract award, Westinghouse will submit to DOE an AP600 specific QA plan. The Plan will be implemented through a quality assurance program and procedures. The program and procedures will provide for activities designed to assure effective implementation of and compliance with the governing requirements.

1990 Plan

- Submit AP600 Quality Assurance Plan

WBS Element 1.1.1 Quality Assurance Plan

Responsibility of Westinghouse

Purpose

The AP600 Quality Assurance Plan (QAP), to be submitted within 60 days of contract award, will describe the Westinghouse quality assurance commitments and programs to be used to control the quality activities effecting the AP600 Detailed Design and Design Certification Program

Approach

The Quality Assurance Plan will be developed based on proven programs and procedures that comply with 10CFR50 Appendix B, NRC Regulatory Guides, NQA-1, and other governing industry codes and standards. The Plan will describe the existing quality assurance programs supplemented as necessary to address AP600 specific requirements. A key feature of the Plan will require that major suppliers develop a Quality Assurance Program Description (QAPD) to show how their existing quality assurance programs, supplemented as necessary, will be applied to AP600 work.

1990 Plan

- The AP600 Quality Assurance Plan will be prepared and submitted to the DOE within 60 days of contract award.

WBS Element 1.1.2 Quality Assurance Programs

Responsibility of Westinghouse and all subcontractors

Purpose

QA program activities include:

- Design and procurement quality engineering
- Records maintenance
- Quality surveillance and Westinghouse subcontractor evaluations and audits
- Customer interfaces and audits of Westinghouse

- QA program maintenance
- Internal audits within Westinghouse

Approach

Design and procurement quality engineering activities include ensuring that work is performed in accordance with the AP600 QAP and in place quality programs, and reviewing and approving items such as procurement documents, design specifications, non-conformance reports and corrective actions proposals. A portion of the activities will be performed at supplier facilities to review, monitor and witness quality activities such as; design documentation, procurements, tests, and to perform in-depth audits to ensure that quality program effectiveness is maintained.

Records maintenance work activities provide for initiation and coordination of records criteria and flow schedules (e.g., responsibility, what, how, how long, and where). Criteria needed to assure generation, traceability, maintenance, and retention of quality documentation for AP600 will be included. QA data packages received suppliers are also indexed, microfilmed, and maintained. In place procedures will be coordinated with program configuration management procedures to ensure all records are maintained and compatible with each other. Departments and individuals responsible for quality records have been trained and will be kept appraised of records criteria. Records technicians' work tasks pertain only to records with no other distracting activities assigned.

Quality surveillance, evaluation and audits of Westinghouse suppliers ensure that suppliers have implemented effective QA programs. Evaluations are used to determine capability of performing technical and quality functions. Such evaluations will be conducted with both new and existing suppliers to ensure activities, including design and test control, are being conducted in accordance with their approved QA programs. Surveillance may be conducted during design, test article manufacture, and testing of systems and components. Surveillance includes witnessing of important test preparation, performance, and results.

Westinghouse will also coordinate and monitor or observe customer audits at the Westinghouse suppliers' facilities. Audit responses to customer audit reports are coordinated and controlled by QA. Customer audit findings (if any) are evaluated by Westinghouse to ensure that corrective actions have been effectively implemented in a timely manner.

QA program maintenance provides for the inclusion of special AP600 quality program criteria in Westinghouse QA Policies and Procedures. This activity also includes review of new regulations, codes, and standards, revising and updating quality programs and procedures to these latest criteria as the program progresses.

Internal audits are performed on a planned and scheduled basis in accordance with QA procedures. Personnel performing these audits are qualified in accordance with NQA-1 and use the services of other technically competent personnel to ensure compliance to codes, standards, and quality program procedures. Supplemental audits are performed on a scheduled or unscheduled basis when needed to correct areas of concern. Corrective actions are tracked to ensure effective and timely implementation. The internal audit program and audits of suppliers are evaluated for an assessment of QA program effectiveness and to identify potential problems for management evaluation and action.

1990 Plan

- The evaluation and qualification of suppliers
- The review of all procurement documents (e.g., design specifications, purchase requisitions, etc.)
- Preparation, review and approval of project specific quality assurance procedures
- Auditing of suppliers compliance to quality assurance requirements

- Auditing of Westinghouse NATD compliance to quality assurance requirements.

WBS Element 1.1.3 Quality Assurance Administration

Responsibility of Westinghouse

Purpose

This activity comprises QA administration functions. Its primary responsibility is management and direction of the QA functions within Westinghouse.

Approach

The activity provides for the coordination and direction of work described in WBS 1.1.1 and 1.1.2. QA administration also includes collection and control of man hours, assignment of personnel scheduling, and quality program training.

1990 Plan

- Staff quality assurance function to authorized level.
- Train staff.
- Provide direction of work described in WBS 1.1.1 and WBS 1.1.2.

WBS Element 1.2 RAM and Systems Engineering

Purpose

The RAM and Systems Engineering function is to ensure application of a comprehensive RAM Plan to all phases and activities of the AP600 program, and to provide the technical direction and coordination of the program to assure a variety of technical performance, utility participation, funding and other program goals are achieved with assurance and discipline.

Approach

Systems Engineering will perform various activities related to the AP600 development including: 1) Functional requirements analysis, allocation, and integration. 2) Implement administrative and technical controls for the coordinated application of the RAM program throughout the design and development process, in accordance with the task descriptions of MIL-STD-785B and MIL-STD-470A, interfacing with all safety (PRA), licensing, QA, and subcontractor activities to assure program objectives are met. (Detailed description of the RAM program elements is contained in section 6.6.2 and technical task description is provided in WBS element 2.1.5.) 3) Coordination and integration of other engineering specialties including Spare Parts, Maintenance Issues, Transportability, Productional and O&M Prediction and Estimation Activities. 4) Perform systems effectiveness and program risk evaluations utilizing the systems engineering process. 5) Evaluate program system and development efforts against the planned technical performance, cost, and schedule goals. 6) Provide overall technical coordination in areas of utility contacts, configuration control, system information packages, and subcontractor interfaces.

1990 Plan

- Issue RAM Program Plan

WBS Element 1.2.1 RAM Plan

Responsibility of Westinghouse

Purpose

This task is to develop a RAM Plan that defines; the RAM tasks and requirements responsive to AP600 Program objectives, assessments to be performed, and the integration of the RAM evaluation of program activities, such as safety, QA, PRA, design certification licensing functions and subcontractors.

Approach

Prepare the RAM Plan, responsive to the AP600 program objectives, in accordance with the task descriptions of MIL-STDs-785B and 407A. The RAM Plan will be developed from analysis of the AP600 Program objectives and coordination with utility team members and EPRI to establish a topdown approach for definition of RAM tasks and requirements. Each RAM task will be defined as to purpose, inputs and outputs, methods and interfacing program activities and organizations. In addition, the RAM Plan will be developed to define the RAM scheduling and coordination requirements for efficient interface actions with Westinghouse and subcontractor organizations. The RAM Plan will be built around the tasks and actions necessary for the development of RAM requirements, incorporation of RAM influence directly into the design process, conduct RAM assessments and integration of the RAM Program with interfacing activities.

1990 Plan

Completion and delivery of the RAM Plan for DOE concurrence within 60 days after contract award in accordance with statement of work M002, and establishment of program RAM objectives, methods, tasks and interfaces.

WBS Element 1.2.2 Reliability, Availability, and Maintainability (RAM) Program Administration

Responsibility of Westinghouse

Purpose

Perform the RAM administration function to ensure that the RAM Plan is executed for all phases of the AP600 Program from the onset of design through to program completion.

Approach

Establish RAM Program task performance controls through work authorization for task budget and schedules. Establish the RAM Plan and direct its implementation by establishing RAM requirements, drawing upon the extensive Westinghouse RAM data base, the Westinghouse hands-on field experience and utility and subcontractor experience. Developing these requirements, their applications in the design process, and RAM assessments of design information will be done by experienced Reliability Engineering personnel under the administrative direction of Systems Engineering. The RAM Program integration with interfacing organizations for proper coordination and feedback of RAM information will also be administered by Systems Engineering.

Systems Engineering will establish and direct administrative controls to ensure RAM Program and Plan implementation, coordination, and communication including

- Quarterly Westinghouse RAM Program status review
- Scheduled interface meetings with subcontractors
- Commitment control and tracking
- Establishment of standard RAM information distribution lists
- Incorporation of RAM requirements, guidelines, and allocation documents into the configuration management system
- Ensure RAM communications with all subcontractors.

1990 Plan

By use of the administrative tools listed above the 1990 RAM program will be implemented throughout the AP600 Program to provide assurance of achieving program objectives, to assess progress toward these objectives to identify potential program problem areas for management evaluation and action, and to provide RAM input for design

improvement.

WBS Element 1.2.3 Design Interface and Coordination

Purpose

The design interface and coordination element provides for centralized systems integration. Portions of the role are described under WBS Elements 1.3.1, 1.3.2, 2.1.2 and 2.1.4, which describes roles in configuration control, design documentation and document review. An additional aspect of systems integration is the establishment and tracking of technical parameters and functional requirements for the AP600 design.

Approach

Under this WBS element, the tracking of technical parameters and functional requirements will be performed by methods of various complexity, depending on the level of data necessary for a particular parameter to ensure that potential performance variances are identified and corrective action taken as necessary to preclude significant adverse cost or schedule impact. Critical parameters will be selected for tracking and will be reported on to DOE at every major design review milestone. Where appropriate, formal Technical Performance Measurement techniques will be used in tracking the technical parameters.

1990 Plan

- The Design Interface and Coordination WBS element will result in periodic tracking of technical parameters and functional requirements, identification to AP600 Management of potential performance variances, and status reports to DOE at major design review milestones.

WBS Element 1.2.4 Coordination of Operations and Maintenance Estimates

Purpose

The purpose of this task is to identify and coordinate joint efforts between utility participants and Westinghouse for the preparation of the AP600 O&M estimate.

Approach

Systems Engineering will initiate and develop a format that will be used to estimate the annual operations and maintenance expenses that the AP600 plant will require. Systems Engineering will then actively seek out utility participants who will be willing to relay recent historical data on expenditures for O&M to Westinghouse for use in the program. This historical data will be categorized in the cost estimate format in a way that would facilitate comparison to the AP600 plant. Systems Engineering will then gather relevant design information that would potentially effect O&M costs and input this information to the utilities so that a comparison can be made of their historical expenses and potential O&M expenses for the AP600 plant based on the design differences.

1990 Plan

- Establishment of a preliminary O&M cost estimate, as well as, an updated detailed O&M cost estimate for the AP600 Plant that has been created out of a joint effort between Westinghouse and operating utilities.

WBS Element 1.3 Configuration Management Administration

Purpose

The objectives of the AP600 configuration management (CM) program are to: 1) assist in achieving, at the lowest cost, the required system, performance,

and operational efficiency; 2) promote the maximum degree of design and development latitude while providing the appropriate degree of technical configuration control; 3) attain maximum efficiency in the management of configuration changes with respect to their necessity, benefit, cost, timing and implementation; and 4) provide a systematic review of all changes to ensure that all primary and secondary effects of the proposed changes are identified and their cost/benefits are weighed in making a decision to incorporate that change.

Approach

The AP600 CM program is implemented and controlled by the AP600 Configuration Management Plan (CMP), which describes the methods and procedures to be used to ensure technical baseline integrity. A Configuration Control Board (CCB), which is chaired by the Deputy Program Director, is established to evaluate all proposed changes. An integrated data management system is used to document all changes and revisions. Document status reports are issued to all program participants to ensure that the most recent documentation, drawings, and specifications are being used.

1990 Plan

- AP600 Configuration Management Plan
- Configuration management procedures

WBS Element 1.3.1 Configuration Management Plan

Responsibility of Westinghouse

Purpose

The AP600 CMP describes the procedures and methods that will be used to establish technical, schedule and cost baselines. It also describes how changes in these baselines are originated, reviewed, approved and documented. The CMP addresses what requirements will be imposed upon our subcontractors, and how they will be monitored against these requirements.

Approach

The CMP will contain information concerning technical baseline identification, change control, configuration accounting and auditing procedures. Interface control will also be addressed, as will any special considerations and/or features of the configuration management process. Procedures for collecting, storing, handling, verifying and reporting of configuration status information will be provided.

1990 Plan

- The Westinghouse AP600 CMP (CDRL #14, DRD #M001), will be submitted to DOE 60 days after contract award.

WBS Element 1.3.2 Configuration Management Program

Responsibility of Westinghouse and all subcontractors

Purpose

The objective of the AP600 CM program is to provide effective program control, so that when technical, schedule and cost baselines are approved, changes to these baselines are controlled through a formal review and approval process. This process assesses the technical, cost and schedule impacts of the proposed change prior to its approval and implementation.

Approach

The four distinct elements in our configuration control approach are: 1) configuration identification – establishing an approved baseline; 2) configuration control – regulating the method of changing established baselines; 3) configuration accounting – documenting the results of approval actions; and 4) configuration audits – verifying the accuracy and

traceability of the configuration management program.

The CCB, as the designated change control authority, controls changes to approved baseline documentation. Changes are proposed to the CCB via an Design Change Proposal (DCP). All organizations that would be affected by a proposed change are informed by the organization requesting the change. Comments and results of such coordinating efforts are indicated in the DCP package submitted for approval. The DCP package includes: 1) a statement of the problem identified and a description of the proposed change; 2) a discussion of the alternatives considered; 3) an analysis that shows the effect of the proposed change; 4) verification of interface compatibility; 5) an estimate of the cost and schedule impact; 6) proposed specification and/or interface control document (ICD) revisions; and 7) the impact on the design if the change is not incorporated. If the change is approved by the CCB, the DCP authorizes revision of all affected baseline program documentation.

Westinghouse CM requirements are imposed on all program participants and subcontractors. Configuration management requirements for subcontractor/vendor work must be compatible with Westinghouse specifications for the components, structure or service being purchased. Specification baselines are the basis of all requirements for subcontractors/vendors, including configuration management requirements. Baseline specifications are established prior to the start of shop fabrication.

1990 Plan

- AP600 Program procedures that describe the preparation, analysis and approval of DCPs will be prepared and issued for program participants
- Procedures will also be developed on how baselined Program documentation is revised following approval of DCPs.
- CCB meeting minutes will be prepared and issued to all affected program personnel.

WBS Element 1.3.3 Configuration Management Program Administration

Responsibility of Westinghouse

Purpose

The CM program administration function will be executed to ensure program baseline integrity and that program participants are working with the most recent, approved versions to AP600 Program documentation, including, but not necessarily limited to drawings; specifications; program plans; and related design documentation.

Approach

A computerized document status accounting system will be used to provide current configuration information. The system uses integrated data base management techniques to provide the combined functions of monitoring document status, drawing release information, hardware configuration, change history, and open items. Configuration status reports, document status reports and hold status reports are issued monthly to all program participants.

Issued documents are revised when engineering change notices and engineering release orders are reviewed and approved. Baseline documents include change control record pages. These pages identify the affected portions, the authorizing engineering change notice, and contain the engineering release order number and revision date.

Rigorous interface control procedures will be imposed on all program participants. ICDs and drawings will be tightly controlled and followed, and the status of the ICDs will be included in the AP600 Document Status Reports.

Program Control and Contract Administration will be responsible for the overall administration of the

AP600 CM program. In this capacity, this department will serve as the secretary to the CCB; be responsible for the preparation, coordination, and issuing of the configuration status reports; and will support the interface control working groups (ICWG) to document and control interface agreements/changes and transmit them to those parties involved in the implementation.

1990 Plan

- Periodic configuration status reports, document status reports and hold status reports will be prepared and issued to all program participants.

WBS Element 1.4 Program Control

The program control activity is used to plan, schedule, budget, monitor, and control the AP600 Program to ensure that all technical, scheduler and budgetary objectives are met. The program planning and control procedures and methods that will be used to manage the AP600 Detailed Design and Design Certification Program follow established procedures for planning, managing, and controlling technical workscopes. These techniques, which are described below in greater detail, have been developed, implemented, and refined on prior DOE and commercial contracts.

Approach

The AP600 WBS serves as the foundation for the Westinghouse management control system. It provides the structure for the organization of all AP600 costs and for all elements of our program schedules. As the total identification of all tasks to be performed on the AP600 Detailed Design and Design Certification Program, the WBS serves as the framework for developing detailed work authorizations and the budgets assigned for that work.

The AP600 master schedule, developed from an overall systems analysis approach, defines the milestones and key control dates for tracking and reporting program status. It is supported by intermediate level schedules, and detailed cost account plans which are used to measure and report program performance. Status of the AP600 schedules will be reported monthly and updated as required.

Actual costs are collected by the Westinghouse Integrated Management and Control System (IMACS) through the use of charge numbers, and compared with the time-phased budget for that effort. Performance is also measured through the application of earned value techniques; variances are calculated, analyzed and reported. Cost performance reports are prepared and issued, along with variance analysis reports and corrective action plans, to DOE and program participants.

Formal and informal AP600 Program reviews will be conducted to assess technical and programmatic status. A formal commitment control system will be used to monitor and report status of all program commitments, internal and external. Document control will be maintained through correspondence logs, a centralized document depository, formalized change control procedures, and a Document Status Report.

1990 Plan

- AP600 Program Management Plan
- DOE required monthly reports
- 1990 and 1991 Cost Participation Plans
- 1990 and 1991 work plans
- CSCSC procedures
- Request validation of management control system

WBS Element 1.4.1 Program Management Plan

Responsibility of Westinghouse

Purpose

The AP600 Program Management Plan (PMP) is an integral part of the AP600 management control system. It describes the methods and procedures used to collect and integrate the cost, schedule, and technical information related to the AP600 Program.

Approach

Our PMP includes a description of the AP600 Program organization, key personnel, program responsibilities, planned accomplishments, management control system, and technical, financial and administrative support systems and controls.

1990 Plan

- The AP600 PMP will be submitted to DOE 30 days after contract award. It will be updated as required to reflect any changes to our AP600 cost plan, manpower plan and/or milestone plan, and any changes made to our management control system or program organization. Copies will be provided to all program participants in addition to DOE.

WBS Element 1.4.2 Program Administration and Control

Responsibility of Westinghouse and all subcontractors

Purpose

The objective of the program administration and control activity is to provide comprehensive, integrated cost and schedule control and follow of the AP600 Program. Detailed schedules and budgets are prepared, approved, implemented and followed to determine program status, assess performance, predict trends and provide early visibility of potential problem areas. Critical program performance information is provided to DOE, the AP600 Program Director, and cognizant program personnel.

Approach

Westinghouse uses an overall systems analysis and planning approach to define, organize, schedule and control the AP600 scope of work. In defining and structuring the AP600 SOW, Westinghouse used a "top down" approach in which the requirements derived from the AP600 requirements were cascaded to lower and lower elements of work. Milestones and key control points were identified, interrelationships established and the activities scheduled. The resulting time-phased network integrates the major contract deliverables with key events, including program reviews and additional commitments, and shows the start and estimated completion dates for accomplishing the work.

The AP600 master schedule, which will be submitted as part of the annual Work Plan, is supported by intermediate-level schedules that provide the necessary level of detail to ensure comprehensive program planning. These intermediate schedules are oriented to elements of the SOW for task control and performance measurement, and serve as the baseline for generating detailed cost account plans. The AP600 master schedule will be statused monthly and updated as required to provide DOE and the AP600 Program Director with critical program status information and an early warning system so that all technical/schedule problems can be quickly identified, tracked, and resolved.

Individual cost accounts are opened for designated task elements of the WBS. A cost account is the standard cost collection point for time-phased cost planning and reporting. It is the lowest level of the WBS at which contract task responsibility is identified, actual costs are accumulated, and performance is measured.

The cognizant Cost Account Managers (CAMs) are responsible for planning and executing time-phased,

detailed budgets for the manpower and other resources that are required to perform the technical scope for the detailed design of the AP600. The estimated manpower, materials and computer charges, and subcontract costs that are required monthly to accomplish the work provide the basis for the month-by-month cost account budget generated by the AP600 Integrated Project Management System (IPMS). The AP600 Program Director will review and approve the estimate before the task is budgeted. The summary of these time-phased budgets represents our AP600 budget baseline, and serves as the basis for our monthly cost performance reports.

As task activity proceeds, IPMS is used to monitor cost and manpower performance against the cost account budget on a cumulative basis and calculates any accumulated variances. Actual costs, both direct (e.g., labor, material, equipment, computer charges) and indirect (overhead, general and administrative), are collected by the Westinghouse centralized accounting system and integrated with IPMS. Problems with manpower and/or costs are identified and closely monitored through weekly variance reports, so that potential problems can be identified and resolved in a timely fashion.

Individual cost accounts are established for each subcontract so that subcontractor/vendor progress can be measured, monitored, and integrated into our system for tracking and reporting purposes.

Following the development of cost account budgets, program status, performance, and variance reporting can begin. The budget value assigned to the resources that are required to accomplish the workscope of the work package will be summarized to the cost account and identified as budgeted-cost-of-work-scheduled (BCWS). The time-phasing of the work package resources will be consistent with the baseline schedules. Budgeted-cost-of-work-performed (BCWP) will be summarized to the cost account when a discrete work package milestone is accomplished. Actual costs incurred as the work is being accomplished will be collected at the cost account level of the WBS and identified as actual-cost-of-work-performed (ACWP). Comparison of BCWS to BCWP will provide schedule status in dollars; ACWP to BCWP will provide cost status. Performance for all cost accounts will be summarized to any desired WBS level. Variances between these elements (BCWS, BCWP and ACWP) will be analyzed and followed.

Document Control

Documents prepared for the AP600 Detailed Design Program will be issued, controlled, and/or revised per standard AP600 CM procedure, using engineering change notices, engineering release orders, and an appropriate review and approval cycle. Change control record pages are included in baseline documents. These record pages identify the affected portion of the document, the authorizing engineering change notice, and revision date.

A document status system will be used to maintain control of all AP600 documents. A computer data base will generate a document status report. This report will be generated monthly and issued to all AP600 Program participants. A document depository will be established and all documentation related to the AP600 Program will be cataloged.

Commitment Control

A computerized program management task tracking system (PMTTS) will be used for AP600 commitment control. PMTTS will supplement IPMS, tracking specific contract commitments, reportable contract milestones, and internal nonreportable planning milestones. PMTTS will provide a complete status report on open program commitments for the AP600 Program Director and program participants and includes all commitments to DOE. This report will contain an identification number assigned for each action, a description of the open action items, the requesting party, the referenced correspondence requesting the action, and the status of the action

relative to its due date. A list of commitments will be provided for each "action party" responsible for accomplishing them. Completion of action items will be indicated when achieved. Printout sorts can be made by action party, chronological order, system, requesting party, and slack time to due date

PMTTS will provide a disciplined method for recording, documenting, and achieving traceability of technical priorities, progress, and problems, and prevent any commitments from being overlooked.

1990 Plan

- Monthly program status reports will be issued to DOE as a means to analyze and evaluate AP600 Program progress, status and costs. The principal management report will be the AP600 Monthly Report, which will contain a status narrative report; Milestone Schedule/Status Report; Labor Management Report; Cost Management Report; and Cost Performance Report, Format. Variance Analysis Reports, with associated corrective action plans, will be prepared when cost and/or schedule variances exceed DOE approved thresholds.
- The WBS, its supporting documentation (WBS Dictionary and WBS/Responsibility Matrix), the AP600 master and supporting schedules, and cost account plans are developed and used to ensure cost and schedule control.
- The AP600 Annual Work Plan will initially be submitted to DOE 30 days after contract award, and annually thereafter. It will include the cost, labor, schedule and milestone plans for the upcoming fiscal year, a narrative description of the tasks and subtasks planned for that year, and a summary of activities completed to date by task. The 1991 Work Plan will be submitted later in 1990.
- The AP600 Cost Participation Plan will be submitted to DOE 90 days prior to the start of the government fiscal year. Our initial submittal will be submitted along with the 1990 Work Plan. It will describe the nature and amount of our expected cost participation share for that year, including sources of that share. The Government's participation share, cost share, and total program costs are also addressed. The 1991 Cost Participation Plan will be submitted later in 1990.
- CSCSC procedures will be prepared and maintained during the life of the AP600 program.

WBS Element 1.5 Program Reviews and Reports

Responsibility of Westinghouse

Purpose

The Westinghouse AP600 Program Office will use formal and informal program reviews, program management performance reports and technical status reports to ensure that DOE is kept fully informed concerning total program status. These reviews will also be used to discuss technical and programmatic issues and concerns, program trends and potential problem areas.

Approach

Formal semi-annual program reviews will be conducted to evaluate technical progress, current design status and program cost status. Reports documenting these reviews will be prepared and issued within 30 days of the review. Informal program reviews will be conducted monthly by the AP600 Program Director to review program status.

1990 Plan

- See WBS Elements 1.5.1, 1.5.2, and 1.5.3 for descriptions of respective 1990 plans.

WBS Element 1.5.1 Program Review Reports

Responsibility of Westinghouse

Purpose

AP600 program review reports will be prepared and used to summarize technical progress, current design status and program cost status.

Approach

AP600 program review reports will contain a summary of program activities to date, current cost and schedule status, a discussion of problem areas and their specific corrective action plans, and expected accomplishments for the following 6 months. Action items resulting from the program review will also be incorporated into the report.

1990 Plan

- Each program review report will be prepared and submitted to DOE and program participants within 30 days after the program review.
- Results and findings from monthly program reviews will be issued, along with action items and corrective action plans, to all program participants.

WBS Element 1.5.2 Design Review Reports

Responsibility of Westinghouse

Purpose

Design review reports will be prepared and issued to summarize the activities and findings associated with AP600 principle design reviews.

Approach

Design review reports will be prepared following each AP600 principal design review. The report will contain summary information resulting from the specific design review, and will include design review meeting minutes, design review findings, clarification to the findings, if required, and action items.

1990 Plan

- Design review reports will be prepared for all AP600 design reviews. Based upon the information contained in the AP600 design review list (CDRL #7, DRD #DRL000), DOE and Westinghouse will jointly decide which design review reports will be required to be submitted as deliverables. These design review reports will be submitted to DOE for information within 30 days after the design review.

WBS Element 1.5.3 CDRL and Other DOE Topical Reports

Responsibility of Westinghouse

Purpose

AP600 Program reports, plans and documentation will be prepared to provide DOE with program performance and status information, planned activities, program schedules, and critical design information. They will be prepared in accordance with DOE requirements, as noted below, and are issued to DOE for information.

Approach

The plans, lists, documents and reports identified in DOE's CDRL will be prepared and issued in accordance with the specific CDRL specifications.

Technical progress reports, topical reports, and the AP600 Final Technical Report will be prepared as required by the Reporting Requirements Checklist provided in Attachment II to the RFP.

Monthly technical progress reports will include information on the technical progress, current status, problems encountered and the corrective actions taken for the tasks defined in the annual work plan. Milestone/schedule status will be included in this report.

The 1990 annual technical progress reports will address the technical accomplishments and progress for 1990.

1990 Plan

- Overall Plant Design Description (CDRL #1, DRD #DD001)
- Overall Plant Design Requirements and Design Parameters (CDRL #2, DRD #DD002)
- System Design Description List (CDRL #3, DRD #SDDL000)
- Design Drawings List (CDRL #4, DRD #DDL000)
- Design Specifications List (CDRL #5, DRD #DSL000)
- Miscellaneous Technical Documents and Reports List (CDRL #6, DRD #MRL000)
- Design Review List (CDRL #7, DRD #DRL000)
- Safety Analysis List (CDRL #8, DRD #SAL000)
- Licensing Review Bases Document (CDRL #11, DRD #DL002)
- Configuration Management Plan (CDRL #14, DRD #M001)
- Reliability, Availability and Maintainability (RAM) Plan (CDRL #15, DRD #M002)
- Quality Assurance Plan (CDRL #16, DRD #M003)

In addition to the reports documents listed above, DOE and Westinghouse will jointly decide on additional documents and drawings that will be added to the CDRL as deliverables. This decision will be based on the information contained in the System Design Description List, Design Drawings List, Design Specifications List, Safety Analysis List, and Miscellaneous Technical Documents and Drawings List. Submittal of these deliverables will be in accordance with the CDRL.

WBS Element 1.5.4 Executive Board Reviews

Responsibility of Westinghouse

Purpose

The AP600 Senior Advisory Board was designed to review technical progress, advise the Program Director in technical and programmatic issues, and provide an independent system of checks and balances to ensure program compliance with DOE orders, current industry standards, and regulatory concerns.

A Utility Advisory Board has also been established to support and assist the AP600 Program Director. This board will be available to review, comment and advise the Program Director and his staff on critical issues facing the commercialization of the AP600, including operability, maintainability, financial considerations, public acceptance and other issues affecting construction of the first plant.

Approach

The AP600 Senior Advisory Board, which is composed of both Westinghouse and non-Westinghouse personnel who have exceptional experience and backgrounds in fields critical to the success of the AP600, reports to the Program Director, but is independent of the AP600 Program organization. Ad hoc members are appointed as needed to supplement the regular membership in their area of special expertise. The Board will also be available for specific consulting as the need arises.
The Utility Advisory Board will be made up of our cost share participants, utility representatives and participants from the EPRI ALWR Utility Steering Committee. It is independent of the Program Office and will report directly to the AP600 Corporate Official.

The Boards will meet periodically to review program status, discuss issues and/or recommend solutions to specific problem areas, if required.

1900 Plan

- The Westinghouse AP600 Senior Advisory Board and the Utility Advisory Board will provide recommendations, as required, to the AP600 Program Director.

WBS Element 1.6 Subcontract Management

Purpose

The subcontract management activity is used to monitor and manage our subcontractors, and vendors/suppliers as required, to ensure that all of their technical and programmatic responsibilities are fulfilled on time and within budget. This activity entails imposing specific cost, schedule and technical requirements on them, as described in WBS elements 1.6.1 - 1.6.3, and measuring their performance against these requirements.

Approach

Westinghouse has gained broad government procurement management experience as a successful operator of six DOE facilities and other significant DOE prime contracts covering thousands of man years of comprehensive subcontracting experience. We will use this experience to develop and implement a subcontract management plan, and supporting program procedures, for the AP600 Detailed Design and Design Certification Program. Our plan will address competitive solicitations, cost/schedule monitoring requirements, CM, small business and small disadvantaged business participation and subcontract administration.

1990 Plan

- Subcontractor Management Plan

WBS Element 1.6.1 Subcontract Management Plan

Responsibility of Westinghouse

Purpose

To use proven effective subcontract monitoring and management techniques for program integration, control of cost/schedule, and soliciting of competitive bids. The subcontract management foundation for the AP600 Detailed Design and Design Certification Program will be CM. The configuration specific to this program will essentially be a communicative discipline among the five major subcontractors and Westinghouse.

In addition to the elements of the subcontract management plan discussed above, Westinghouse has analyzed participation of small and small disadvantaged businesses. This aspect of subcontract management is identified by a separate plan identifying the goals for utilizing small business and small disadvantaged business concerns.

Approach

Westinghouse will identify what requirements will be imposed on the subcontractors to measure their performance and ensure that the work of all subcontractors is integrated into the work effort.

CM for the AP600 Detailed Design and Design Certification Program will be imposed on all subcontractors and subvendors. Westinghouse will require that our subcontractors prepare internal CM plans and procedures which will be reviewed or approved to ensure that Westinghouse practices are addressed and implemented. Periodic audits will be conducted by Westinghouse to determine compliance with the procedures and pursue immediate corrective action as required.

The program baseline specific to the AP600 Detailed Design and Design Certification Program will provide uniform documentation for all program participants. All subcontract changes proposed to the baselined documentation must be submitted to Westinghouse for approval prior to their implementation. To further the subcontract management commitment under program configuration, interface control procedures will also be imposed.

Other key elements of the subcontract management plan are cost/schedule monitoring and subcontract administration. These elements are discussed, in detail, in the subsequent WBS elements (1.6.2 and 1.6.3, respectively).

1990 Plan

- The development and implementation of our Subcontract Management Program, as outlined in our Subcontract Management Plan, will ensure that our subcontracts are adequately managed, and that the proper level of control is imposed on them. Cost, schedule, and technical performance will be monitored to ensure that technical and programmatic data, information, deliverables and other documentation follow Westinghouse procedures, meet DOE requirements, and is integrated for total AP600 Program performance information and assessment.

WBS Element 1.6.2 Cost/Schedule Monitoring

Responsibility of Westinghouse

Purpose

Westinghouse effectively monitors the performance of subcontractors by establishing schedule/cost milestones. These milestones are integrated with the program schedule and are negotiated as part of the subcontract agreement. Individual cost accounts utilizing the schedule/cost milestones are established for each subcontract. Subcontractor/vendor progress is compared to these milestones on a monthly basis. Any changes to the milestones and/or schedules are performed in concert with the program's change control system.

Approach

Formal cost/schedule control requirements are imposed on our subcontractors as part of their contractual agreement. The level of control that is imposed on them is based on the size of the subcontract and the complexity of the work to be accomplished. Every attempt is made to ensure that the proper level of control is imposed and that no new systems are needed by the subcontracts to meet these requirements.

For both fixed price/progress payment or cost type subcontract purchase orders, Westinghouse will establish monthly cost/schedule milestones at order award. These milestones will enable Westinghouse to objectively monitor and measure subcontractor scheduler performance to ensure total cost/payment control and program status. These milestones remain fixed for the life of the subcontract except for adjustments made due to change notices and/or modifications to the subcontract purchase order(s).

Purchasing will perform detailed systematic reviews including; periodic verification visits to our subcontractors' locations, weekly teleconference calls, and reviews of formally submitted schedule status reports to assess and evaluate subcontractor performance.

1990 Plan

- Westinghouse has established procedures for effective cost/schedule monitoring of subcontractors. In addition to providing an effective way to monitor our subcontractors, the information generated by our subcontractor cost/schedule control activity is integrated in our monthly cost performance reports submitted to DOE; this practice ensures that both DOE and Westinghouse management receive accurate, timely and totally integrated program status information.

WBS Element 1.6.3 Subcontract Administration

Responsibility of Westinghouse

Purpose

Westinghouse utilizes the same procurement personnel throughout all phases of the contracting process, from pre-procurement planning through contract closeout. Administrative control is greatly enhanced through use of personnel who are familiar with the subcontractor and the required work scope during pre-procurement, solicitation and negotiation. Westinghouse procurement, technical, and support personnel work as a team on all aspects of contract/subcontractor administration to provide controlled and effective communication with the subcontractor and to ensure that the proper expertise is applied to all facets of subcontract management.

Approach

Subsequent to order award, required subcontractor documentation is submitted to Westinghouse on an approval request form that provides all essential contractor-supplied contract and technical data and a well-documented trail of technical and contractual disposition of the documentation. Subcontract changes and/or amendments are handled in the same exacting manner and require the approval of all departments initially involved in the procurement.

1990 Plan

- Initial subcontracts
- Subcontract change notices, as required

3.2 DETAILED DESIGN AND DEVELOPMENT

Detailed design and development activities include six level 2 elements -- design CM, plant systems, plant arrangement and construction methods, structural design and analysis, plant analysis, and testing programs. These are the engineering activities necessary to produce the detailed design information for NRC certification and for procurement and construction of an AP600 plant.

WBS Element 2.1 Design Management

Purpose

The purpose of this element is to provide the methods, reviews, activities, and documentation to integrate, control and evaluate the AP600 plant design.

Approach

Design management incorporates the engineering activities to maintain design basis documents; to review the plant design against requirements and to prepare evaluation reports; to control the plant design configuration; and to review and guide the plant design as it evolves to ensure the integrated plant design effectively meets plant level requirements. Plant evaluations will be performed relative to EPRI ALWR Utility Requirements, utility review findings, DOE review findings, RAM requirements, value engineering reviews, safety requirements, and other AP600 plant level criteria. RAM assessments including the scope of activities specified in MIL-STDs 785B and 470A will be performed as an integrated part of the AP600 design, test and safety programs. Design reviews will be held to minimize technical risk associated with design of systems, equipment, components, or structures that differ from previous designs. Changes to the plant design will be controlled through execution of the configuration controls established by the CMP. A plant data base will be established and administrated and controlled to provide on-going support throughout the program. Standard component specifications and equipment qualification specifications for the plant design will be generated and will be applied across the entire program via the Interface Control Working Group (ICWG) that will also provide direction and control for all design interfaces. Frequent technical meetings, written communications, a computer-based plant data base, and evaluation findings will be used to integrate the design results from the various design disciplines. This activity also includes a series of six utility review workshops to be held for the specific purpose of obtaining technical input from experienced utility personnel regardig AP600 design features and the utility requirements implementation basis.

1990 Plan

The primary design basis documentation activities during 1990 will be to update the plant level design documents and to conduct an initial series of design reviews. Theupdated design documents will reflect the evolving design configuration decisions. Major milestones are as follows:

- Update Plant Design Criteria Document
- Update Plant Parameters List
- Issue Plant Parameters and Top Level Operating Criteria
- Prepare Overall Plant Description
- Review of the EPRI ALWR Passive Plant Requirements as Available
- Conduct Initial Utlity Worksthops
- Select Engineering Data Base Manager
- Develop Access, Security, Control and Configuration Management Aspects of the Data Base
- Develop Preliminary Evaluation of Occupational Radiation Exposure
- Develop Plant-Level RAM Requirements and Goals

- Generate RAM Critical Items List

WBS Element 2.1.1 Design Basis Documentation

Responsibility of Westinghouse

Purpose

This WBS element provides for maintaining and communicating the AP600 plant design basis documents and conducting design reviews. This documentation is needed to communicate the design bases to the plant designers and reviewers, and as a record of the design bases to support plant activities throughout the life of the plant.

Approach

During the AP600 conceptual design program the initial DBD was established including Plant Design Criteria, Plant Parameter List, and Plant Description Report. These documents and a Design Codes and Standards document will be kept current during the proposed program as the detailed plant design evolves. These documents will be maintained as part of the CM program, and will be issued to DOE for review and concurrence as required by the CDRL.

Westinghouse engineering practices include the use of design reviews to minimize technical risk associated with design of systems, equipment, components, or structures that differ from previous designs. These design reviews are conducted by providing the design information to a panel of individuals, independent of the designers, for review and comment. All resulting comments are addressed by the designers and a design review record is prepared to document the comments and their resolution.

1990 Plan

The primary design basis documentation activities during 1990 will be to update the plant level design documents and to conduct an initial series of design reviews. The updated design documents will reflect the evolving design configuration decisions.

- Update Plant Design Criteria Document
- Update Plant Parameters List
- Prepare Overall Plant Description
- Establish List and Schedule of Design Reviews
- Coordinate Design Reviews as required for major plant fluid systems

WBS Element 2.1.2 EPRI ALWR Utility Requirements Document Review

Responsibility of Westinghouse

Purpose

The AP600 plant design will be evaluated relative to the utility requirements being developed by EPRI for ALWR passive plants. These requirements are being developed based on the vast LWR experiences of utilities associated with EPRI. The purpose of this evaluation is to ensure that the AP600 plant design will satisfy the ALWR requirements important to utilities.

Approach

Westinghouse is an EPRI contractor in the EPRI ALWR program and, as such, is benefiting from working directly with EPRI, utilities and other industry contractors in developing information used by EPRI and the ALWR Utility Steering Committee to establish ALWR design requirements. This association ensures that Westinghouse technical staff on the AP600 program have a solid understanding of the utility requirements and the experience base on which they are founded.

The EPRI ALWR requirements will encompass all aspects of plant design, licensing, construction, operation and maintenance. Each of these requirements will be reviewed in the AP600 evaluation and the specific manner in which the

requirement is implemented for AP600 will be described.

This activity also includes a series of six utility review workshops to be held for the specific purpose of obtaining technical input from experienced utility personnel regarding AP600 design features and the utility requirements implementation basis.

1990 Plan

- Review of the EPRI ALWR passive plant requirements as available
- Conduct initial utility workshops

WBS Element 2.1.3 Plant Computer Aided Engineering Data Base

Responsibility of Westinghouse

Purpose

This task will establish the plant data base and provide for its administration, control, and on-going support throughout the AP600 Detailed Design and Design Certification Program.

Approach

The plant data base system will utilize a 3-D electronic model of the physical plant and an associated design data base system. The system will serve as an integral design tool through its control and provision of authorized design information.

In accordance with the established configuration control procedures, a Westinghouse data base administrator will be responsible for the system. This data base administrator will maintain appropriate security and schedule updates to the data base for authorized design data.

The programmatic controls defined by the AP600 CM program will be addressed in the establishment and administration of the plant data base and its interfaces. The system will be tightly integrated with the overall CM program. It will help to control changes, provide an improved ability for project management to evaluate the impact of those changes, and track the status of the design.

A centralized electronic model and data base will be maintained in a "currently approved" status, such that all members of the design team will have access to the controlled data. Designers will work with local copies of the data base, which can be changed freely, and the centralized model will be up-dated from these working copies at defined milestones.

The extensive hardware and software systems and communication networking facilities available within Westinghouse will be employed using standardized protocols and conventions to establish the plant data base and its interfaces. A systematic and modular approach to system set-up will provide an architecture which can be efficiently maintained throughout the program.

Personnel will be trained on the use and capabilities of the system so that maximum benefit from its application is realized.

1990 Plan

The engineering data base will need to be defined in 1990. Interfaces will be developed between the 3 dimensional model to transfer data between the 3D model data base and the engineering data base. Similar interfaces need to be developed for two dimensional drawings. Interfaces between the main frame data base and engineering work stations need to be established and communication links created to permit access to the data base by all of the AP600 contractors. Milestones include:

- Select Engineering Data Base Manager
- Develop Interface with 3D & 2D Drawing Systems
- Develop Interface to Engineering Work Station

- Determine Data to be Generated in 1990 and Develop Data Structure for this Data
- Develop Access, Security, Control and Configuration Management Aspects of the Data Base

WBS Element 2.1.4 Design Integration

Responsibility of Westinghouse and Bechtel

Purpose

The design integration and configuration tasks involve integrating all of the various systems designs to ensure that a complete and functional plant design is produced. Standard component specifications and equipment qualification specifications will also be generated under this task in order to ensure adequate emphasis is placed on system interfaces.

Approach

This function will ensure that system designs will operate correctly to meet system and plant performance goals. This will be accomplished through the use of controlled interface documentation between the AP600 designers, within Westinghouse and Subcontractors' organizations. In controlling these interfaces, Westinghouse Configuration Management requirements will be imposed on all program participants.

Subcontractors will, as required, provide input to or prepare configuration documents, attend technical interchange meetings and design reviews, recommend technical changes, evaluate proposed changes to baseline documents, provide specialized information to the Westinghouse CCB, and verify incorporation of changes to approved documentation, hardware and/or software.

This task also provides for the generation of equipment qualification specifications for the plant design.

1990 Plan

Integration of design interfaces for the overall plant design between Westinghouse and subcontractors will result in the following activities in 1990.

- Westinghouse will receive input from Subcontractors as needed to produce the AP600 Information package (e.g., source shielding data, summary system descriptions and BOP systems list).
- A standard interface will be developed between the structural modules and the plant structure.
- The AP600 Information Package (first issue) will be produced, and will include such information as ALARA guidelines, chemistry guidelines, and the radiation analysis manual.
- The first draft of the equipment qualification procedure will be produced.

WBS Element 2.1.5 Reliability, Availability and Maintainability

Responsibility of Westinghouse and all subcontractors

Purpose

A strong program is proposed to ensure that the AP600 meets RAM requirements necessary for plant economic performance and safety. RAM assessments including the scope of activities specified in MIL-STDs 785B and 470A will be performed as an integrated part of the AP600 design, test and safety programs.

Approach

The proposed approach is detailed in a preliminary plan. That plan will be refined in the first 60 days of

the project. It demonstrates a Westinghouse commitment to detailed implementation of RAM methodology to verify and improve the AP600 final design.

The RAM plan, outlined below, comprises tasks in three major categories:

- Develop RAM requirements
- Conduct RAM assessments
- Integrate RAM program

Develop RAM Requirements

The first activity after finalizing the RAM plan will be to develop a quantitative statement of design requirements related to RAM, based on the SOW and further DOE direction, an analysis of the ALWR requirements identified by EPRI, and discussions with architect engineering (AE) and utility participants. Certain RAM requirements will be derived from economic objectives, e.g., to achieve low overall generating cost implies a high equivalent availability. As assessments are made on the system level, RAM requirements will be allocated among lower-level systems and components.

Conduct RAM Assessments

The reference design and any identified changes to design will be analyzed to independently verify plant equivalent availability and maintenance factors. Comparisons between calculated RAM performance and allocated RAM targets will be made to verify and improve the design. All major components will be screened first using failure modes, effects and criticality analysis (FMECA) and checklists. More detailed analyses will then be made for critical (i.e., high unavailability or maintenance cost) equipment.

Integrate RAM Program

RAM assessments will guide the design and test programs and form part of an overall optimization of cost and performance. RAM studies will also be used to confirm that the potential for human error is minimized for both operating and maintenance personnel. These estimates, failure rates and repair times from the RAM tasks will support the QA, PRA and design certification programs.

1990 Plan

The following tasks will be completed in 1990.

- Develop RAM plan and schedule
- Identify RAM tasks
- Integrate RAM plan with QA & CM plans
- Develop Plant Level Allocations and goals
- Top level forced unavailability allocations to systems
- Top level R&M outage time allocations to systems.
- Top level critical items list (based on historical data not FMECA)
- Develop Westinghouse RAM input to program Review Report

The following tasks and their initiation are dependant on the design schedule, and may be started but not necessarily completed in 1990.

- Propose system design changes to improve plant RAM performance.
- Develop and maintain AP600 RAM data base.
- Review existing test specifications for RAM inputs.
- RAM topical report on availability and trip frequency.

WBS Element 2.2 Plant Systems

Purpose

The plant systems WBS element provides for the detailed design of all plant systems.

Approach

The starting point for the detailed design of plant systems will be the existing AP600 conceptual design for each system. A systems engineering approach is used. Detailed design criteria will be developed for each system. Design detail for each system and its associated equipment will be developed through the established design process for each type of system and for each piece of equipment in the systems. The detailed design process includes the production of engineering calculations, drawings, specifications, and interface requirements to demonstrate that the system design meets its design criteria and supports the integrated plant design. The results of design reviews, safety and risk analysis, RAM analysis, test results, and plant cost and schedule will be iteratively factored into the design process. A change control process will review and approve any changes made to the current AP600 design.

1990 Plan

Additional design information will be developed for each of the plant systems. Emphasis is given to developing the detailed design information for the systems and major components that is needed to design the plant structures and to develop detailed layout of equipment, piping, cabling, and ducting within the plant. Specific plant systems milestones are as follows:

- Develop reactor general assembly drawing and reactor system functional requirements document.
- Establish Preliminary Reactor Coolant System Interface Requirements
- Establish reactor coolant system loop layout showing the location and interaction of all the RCS components.
- Establish Preliminary Nuclear Fluid System Interface Requirements
- Establish Preliminary Auxiliary Fluid System Interface Requirements
- Establish Preliminary Alarm System Functional Requirements
- Develop Overall I&C System Architecture Requirements
- Establish Preliminary Electrical System Interface Requirements
- Establish Preliminary HVAC System Interface Requirements
- Establish Preliminary Radioactive Waste System Interface Requirements

WBS Element 2.2.1 Reactor System

Responsibility of Westinghouse

Purpose

This task will provide the analyses, drawings, and specifications to functionally define the reactor core, the reactor vessel, the reactor vessel internals, the integrated head package and the control rod drive mechanisms to a level sufficient to support design certification.

Approach

Each component within the reactor system will be designed, analyzed and evaluated to ensure that the functional objectives are achieved in a safe and reliable manner. Nuclear, thermal/hydraulic and structural (stress) analyses will be performed for boundary normal and anticipated transient conditions. Each element of the reactor system will be designed and evaluated for operational RAM. Functional specifications along with design requirements will be written for each component. Layout and assembly drawings will be prepared. Intermediate design reviews will be conducted on the

reactor system components and modifications will be incorporated into the design based on the review findings.

1990 Plan

- A reactor general assembly drawing will be developed along with a reactor system functional requirements document.
- The reactor system specification document will be started with Sections 1 and 2 being completed.
- The preliminary interfaces between the reactor system and other systems, and interfaces between reactor system components will be established as the Reactor System Interface Control Document.
- The component functional requirements specification and the new incore instrumentation systems layouts will also be completed.

WBS Element 2.2.2 Reactor Coolant System

Responsibility of Westinghouse

Purpose

The purpose of this task is to develop the design of the reactor coolant system and its auxiliary components to a design level sufficient to support design certification and accurate plant cost and construction schedule quantifications. The design of the reactor and the major components is covered by WBS 2.1.1 and 2.1.3. Because of the importance of this system to certification, its design will be developed to a high level of completion. The design is to meet overall plant simplification, safety, economic, and RAM goals.

Approach

This task will involve the integration of many activities in a systems engineering approach. The process will begin with a review of the design developed in the AP600 Conceptual Design Program. This review will include inputs from the preliminary NRC review, the EPRI passive plant utility requirements (chapter 3), a value engineering session, and detailed reviews with utilities covering design, operation, and maintenance. Out of this review will come the identification of design issues and formal system design criteria.

The preliminary detailed design will be developed using trade-off studies with parallel safety analysis, PRA analysis, plant performance analysis, RAM analysis, radiation exposure analysis, plant layout and modularization efforts, and cost analysis. Calculations will be performed to ensure that design criteria are satisfied. Reviews will be held with equipment vendors to ensure adequacy of the system requirements and to procure approved-for-layout equipment outline drawings. The resulting detailed system designs will feed information into the design of the instrumentation system, electrical system, plant layout, pipe and cable routings, and modularization, as well as provide updates of the plant cost estimate and construction schedule.

A formal intermediate design review of this system will also be performed. The system design would than be finalized for the SSAR inputs, using data from tests conducted in the beginning of the Detailed Design and Design Certification Program and additional plant analysis. The SSAR analysis would be based on this update of the systems designs. The AP600 licensing effort will be supported through the preparation of the applicable portions of SSAR Chapters 1, 3, 5, 7, 8, and 16.

As a result of the NRC review of the SSAR and the resolution of their comments, a minor update of the system documentation will be made at the end of the program for consistency with the Final Design Approval (FDA).

1990 Plan

The configuration of the Reactor Coolant System is of importance to the other fluid systems and to many other parts of the design. Therefore, 1990 activities

will focus on development and provision of more detailed system design information and interface requirements. Work will also continue to ensure that the RCS design under development meets current industry requirements, using a Utility Workshop and an evaluation against the EPRI ALWR Requirements Document.

- Establish Functional Requirements and Design Criteria
- Establish Preliminary System Interface Requirements
- Issue Preliminary System Layout Requirements
- Issue Updated System Documentation

WBS Element 2.2.3 Reactor Coolant System Major Components

Responsibility of Westinghouse

Purpose

In addition to the reactor vessel and its associated components, the RCS has four other major components: the steam generator, the primary coolant pumps, the pressurizer and the primary coolant piping. The purpose of this task is to provide the necessary analyses, drawings and specifications for these four components to a level sufficient to support design certification.

Approach

The four major RCS components will be designed, analyzed and evaluated to ensure that the functional objectives are achieved in a safe and reliable manner. Scoping level thermal/hydraulic and structural analyses for all expected boundary modes of operation, including transient conditions, will be performed. Functional specifications, configuration layouts and design outline drawings will be prepared and maintenance/inspection requirements will be documented. The design and operational requirements of these components will also be used to develop the design of the RCS supports; that is, the structural members required to adequately support these components as well as the reactor vessel under operational conditions including seismic events. Intermediate design reviews will be conducted and modifications identified by the review incorporated will be in the designs.

1990 Plan

- The reactor coolant system loop layout will be completed showing the location and interaction of all the RCS components including the reactor system.
- Functional specifications will be developed for all of the major components along with the identification of the component interfaces.
- The preliminary design review for the reactor coolant pump will be completed.

WBS Element 2.2.4 Nuclear Fluid Systems

Responsibility of Westinghouse

Purpose

The purpose of this task is to develop the design of the passive safety systems and other nuclear systems and their components to a level sufficient to support design certification and to accurately quantify the plant cost and construction schedule. Because of the importance of these systems to certification, these designs will be developed to a high level of completion. The designs are to meet overall plant simplification, safety, economics, and RAM goals.

Approach

This task will involve the integration of many activities in a systems engineering approach. The process will begin with the designs developed in the AP600 Conceptual Design Program. This will include inputs from the preliminary NRC review, the EPRI passive plant utility requirements (chapters 3,4,5), a value engineering session, and detailed reviews with utilities covering design, operation, and

maintenance. Out of this review will come the identification of design issues and formal system design criteria.

The preliminary detailed design will be developed using optimization studies with parallel safety analysis, PRA analysis, plant performance analysis, RAM analysis, radiation exposure analysis, plant layout and modularization efforts, and cost analysis. Calculations will be performed to ensure that design criteria are satisfied. Reviews will be held with equipment vendors to ensure adequacy of the system requirements and to procure approval for layout equipment outline drawings. The resulting detailed system designs will feed information into the design of the instrumentation system, electrical system, plant layout, pipe and cable routings, and modularization, as well as provide updates of the plant cost estimate and construction schedule.

Formal intermediate design reviews of these systems will also be performed. The system designs will then be finalized for the SSAR inputs, using data from tests conducted in the beginning of the Detailed Design and Design Certification Program and additional plant analysis. The SSAR analysis will be based on this update of the systems designs. The AP600 licensing effort will be supported through the preparation of the applicable portions of SSAR Chapters 1, 3, 5, 6, 7, 8, 9, and 16.

As a result of the NRC review of the SSAR and the resolution of their comments, a minor update of the systems documentation will be made at the end of the program for consistency with the FDA.

1990 Plan

Since the configuration of these fluid systems is of importance to many other parts of the design, 1990 activities will focus on development and provision of more detailed system design information and interface requirements. Work will also continue to ensure that the design under development meets the current industry requirements, using Utility Workshops and evaluations against the EPRI ALWR Requirements Document.

- Establish Functional Requirements and Design Criteria
- Establish Preliminary System Interface Requirements
- Develop Preliminary Detailed Layout Requirements
- Prepare Updated System Documentation

WBS Element 2.2.5 Steam and Power Systems

Responsibility of Westinghouse and Southern Company

Purpose

The purpose of this task is to develop the steam and power conversion systems to a design level sufficient to support design certification and plant cost and construction schedule quantifications. Because these systems are less important to certification, these designs will be developed to a lesser degree than those of the nuclear fluid systems, except where they significantly impact the plant cost and construction schedule. The designs are to meet overall plant simplification, safety, economics, and RAM goals.

Approach

This task will involve the integration of many activities in a systems engineering approach. The designs developed in the AP600 Conceptual Design Program will be reviewed. This review will include data from a review of the EPRI passive plant utility requirements (chapter 2), a value engineering session, and detailed reviews with utilities covering design, operation, and maintenance. Resulting from this review will be the identification of design issues and formal system design criteria.

Preliminary design efforts will include system optimization studies, RAM analysis and cost

analysis. Calculations will be performed to ensure that the design criteria are satisfied. The size of major equipment will be determined based on vendor information or past plant layouts. The resulting preliminary system designs will feed information into the design of the instrumentation system, electrical system, plant layout, pipe and cable routings, and modularization, as well as provide updates of the plant cost estimate and construction schedule.

A formal design review will be conducted to assure full system integration into the overall plant performance. The system designs are then completed in sufficient detail for the SSAR inputs.

It is anticipated that as a result of the NRC review of the SSAR and the resolution of their comments, a minor update of the system's documentation will be made at the end of the program for consistency with the FDA.

1990 Plan

The 1990 plan is to allocate resources to the preliminary design of five of the twelve systems identified in this WBS. No significant work other than that required for interface with other system design or with building designs shall be accomplished on the second priority systems. The five priority systems are Turbine, Main Steam Condenser, Condensate and Main and Startup Feedwater Systems. For these systems the following design milestones shall be achieved:

- Review of EPRI Requirements
- Functional Requirements and Design Criteria
- Preliminary System Interface Requirements
- Preliminary System Layout Requirements
- Updated System Documentation
- Equipment Outline Drawings for Turbine and Condenser

WBS Element 2.2.6 Auxiliary Fluid Systems

Responsibility of Westinghouse, Southern Company and Bechtel

Purpose

The purpose of this task is to develop the cooling water and other support systems to a design level sufficient to support design certification and to determine the plant cost and construction schedule. Because these systems are less important to certification, these designs will be developed to a lesser degree, except where they significantly impact the plant cost and construction schedule. The designs are to meet overall plant simplification, safety, economics, and RAM goals.

Approach

This task will involve the integration of many activities in a systems engineering approach. The designs developed in the AP600 Conceptual Design Program will be reviewed. This review will include inputs from a review of the EPRI passive plant utility requirements (chapters 8,9), a value engineering session, and detailed reviews with utilities covering design, operation, and maintenance. Resulting from this review will be the identification of design issues and formal system design criteria.

Preliminary design efforts will include system optimization, RAM analysis, and cost analysis. Calculations will be performed to ensure that the design criteria are satisfied. The size of the major equipment will be determined based on vendor data or past plant layout information. The resulting system designs will feed information into the design of the instrumentation system, electrical system, plant layout, pipe and cable routings, and modularization, as well as provide updates of the plant cost estimate and construction schedule.

A formal intermediate design review will be

conducted to assure full system integration into the overall plant performance. The system designs are then finalized in sufficient detail for input to the SSAR.

It is anticipated that as a result of the NRC review of the SSAR and the resolution of their comments, a minor update of the systems documentation will be made at the end of the program for consistency with the FDA.

1990 Plan

The 1990 work plan will concentrate efforts on seven of the higher priority systems in the WBS. No significant work other than that required for interface with other priority system design or with building design shall be accomplished on the eight remaining systems. The priority systems are Component Cooling, Service Water, Circulating Water, Chilled Water, Compressed Air, Fire Protection and Containment Hydrogen Control. For these systems the following design milestones shall be achieved:

- Review of EPRI Requirements
- Functional Requirements and Design Criteria
- Preliminary System Interface Requirements
- Preliminary System Layout Requirements
- Updated System Documentation

WBS Element 2.2.7 Main Control Room, Emergency Control Room, Technical Support Center

Responsibility of Westinghouse

Purpose

The purpose of this task is to design the major operations centers for the AP600 plant. Primary effort is placed on the main control room and emergency control room. Location, function, and layout of the technical support center is also included.

Approach

A function based task analysis (FBTA) will establish the design basis for the AP600 main control room, emergency control room, and technical support center. This analysis uses functional decomposition of the plant's processes to satisfy NUREG-0700, Appendix B, "Control Room Design Review, Systems/Operations Design Analysis Techniques," and the newly issued IEEE Standard 1023 "IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations."

The man-machine interface (MMI) designer is responsible for ensuring that the man-machine interfaces are rigorously and consistently defined for the over 60 AP600 plant systems which interface with the main control room, emergency control room, technical support center, and instrumentation and control (I&C) systems (WBS 2.2.8). The Interface Documentation Sheet (Table 3-6) defines system parameters, the needs of the various data users, and operator actions. It is the vehicle used for plant systems input to the MMI design.

A team consisting of persons skilled in control room design, function based task analysis, human factors engineering, fluid and reactor systems, protection and control functions, instrumentation and control systems, plant operations, maintenance and testing, and training and procedures will assist the MMI designer integrate all factors. Access to other areas of expertise will be available and used as necessary to support the human environment, specifically as related to lighting, verbal communications, and radiation control.

1990 Plan

- Preliminary functional design of the workstations including the layout, the alarm system and the display system

- The definition of the physical and electrical interfaces between the control stations and the support systems
- A preliminary System Specification Document (SSD), which contains the functional requirements/design criteria, the system design description, the layout require-ments and the environmental requirements will be issued for each operator interface area. This will include Main Control Board, Alarm System, Display System, Emergency Control Room, and Technical Support Center.
- Preliminary Alarm System Functional Requirements will be issued
- Preliminary Function Based Task Analysis will be developed

WBS Element 2.2.8 Instrumentation and Control Systems

Responsibility of Westinghouse

Purpose

The purpose of this task is to design the integrated I&C system for the AP600 that satisfies the needs of the entire plant, both the nuclear steam supply system (NSSS) and the balance of plant. The overall I&C architecture consists of individual microprocessor-based I&C systems and the communications network that links these systems. Some of these systems provide the major functions of protection, control, logic, alarm, and display. Others are dedicated to specific monitoring functions such as rod position indication, radiation, metal impact, acoustic leak detection, gross failed fuel and core barrel vibration. The main frame plant computer is also part of the integrated I&C system performing duties beyond the capabilities of the smaller distributed processors.

The individual systems are identified as follows:

- Overall I&C system architecture
- Protection system
- Control system
- Logic system
- Rod control system
- Rod position indication system
- Qualified data processing system
- Plant alarm system
- Operational display system
- Anticipated transient without scram mitigation system actuation circuit (AMSAC)
- Plant computer
- Incore instrumentation
- Radiation monitoring system
- Metal impact monitoring system
- Acoustic leak detection system
- Core barrel vibration monitoring system
- Inadequate core cooling monitor
- Sensor response and rod drop time test chart
- Diagnostic monitor system
- Real time data base manager for monitor bus

Approach

Westinghouse utilizes a very thorough system development and implementation process (SYS/DIP) that is in accordance with a detailed verification and validation (V&V) program. The primary purpose of the V&V program is to determine that design objectives have been met in the production of an I&C system. The process is structured to enable significant verification activities to be performed in parallel with system development and implementation efforts. The SYS/DIP provides a systematic documentation structure required for a successful design and implementation process. Figure 3-1 contains a traceable, step-by-step evolution of the system development and implementation phases and a simultaneous verification process. Validation is performed at the end of the process against the design requirements.

The V&V plan considered for a particular project is determined by the type of I&C system involved. The criticality of the project to the accomplishment of safety and power production goals determines the level of V&V that is applied to that project.

The program encompasses all aspects of the system design, from the software and hardware entities to the system integration. Emphasis is placed upon system software because of the increasingly important role software plays in the operation of I&C systems.

1990 Plan

- A preliminary definition of the physical and electrical interfaces between the various instrumentation systems and the support systems.
- A preliminary System Specification Document (SSD) for Reactor Protection System, Integrated Control System, and Nuclear Control System will be issued. Each SSD contains preliminary versions of the functional requirements/design criteria, the system design description, the layout requirements and the environmental requirements.
- Preliminary I&C System Architectural Requirements will be issued.

WBS Element 2.2.9 Electrical Systems

Responsibility of Bechtel and Burns and Roe

Purpose

The purpose of this task is to develop a total plant electrical system design, with documentation to fulfill all functional, design, and regulatory criteria and requirements in sufficient detail to support AP600 plant design certification. The design is to meet overall project simplification, economic, and operational goals.

Approach

The electrical design developed during the conceptual design phase established that significant simplification was feasible and that Class 1E diesel generators to support plant safe shutdown could be eliminated. This concept was based on the reduction of Class 1E load requirements due to the passive design approach for the AP600.

The detailed design and development effort to support NRC Design Certification will focus on the development of the simplified electrical design concepts established to date in sufficient detail to support completion of the overall plant design.

This task will include preparation of detailed one-line and functional diagrams, system descriptions, and equipment specifications for all electrical systems, to support the submittal of the SSAR and confirm overall plant equipment layout and system design requirements. The design effort will be supported by detailed analyses for sizing equipment such as motor control centers and switchgear, load studies, and voltage drop calculations. RAM evaluations will be factored into the design. Manufacturer's information will be used for all major equipment to establish design parameters. Relay selection and settings will also be established and incorporated into the design and equipment specifications.

System descriptions will be updated based on the final one-line and functional diagrams and operational requirements. Interface requirements with offsite power and plant instrumentation and control systems will also be established and incorporated into the descriptions, and plant criteria documents.

Equipment specifications will be developed in sufficient detail to support the future preparation of compete technical and procurement specifications. Vendor information will be obtained for all major equipment, such as transformers, switchgear, motor control centers and batteries. These specifications will also serve as the basis for confirming costs and updating the capital cost estimate.

Electrical one-line diagrams, arrangement of the high voltage circuit breakers, disconnects, buses, and

structures will be developed for the switch yard along with utility interface requirements.

The AP600 licensing effort will be supported through the preparation of SSAR Chapter 8 and applicable portions of Chapters 1, 3, 7, and 9. These will be prepared in accordance with the standard review plan of NUREG 0800.

1990 Plan

The 1990 work plan will concentrate on the system design aspects of the electrical design. In addition, a study will be conducted to determine the extent that modularization of electrical equipment will provide a benefit to AP600. The following design milestones shall be achieved:

- Review of EPRI Requirements
- Design Criteria on Functional Requirements
- Electrical One Line Drawings
- System Descriptions
- Equipment Outline Drawings
- Preliminary System Interface Requirements

WBS Element 2.2.10 HVAC

Responsibility - Burns and Roe and Bechtel

Purpose

The purpose of this task is to develop a detailed total plant heating, ventilation and air-conditioning (HVAC) system design, with documentation to fulfill all functional, design, and regulatory criteria and requirements in sufficient detail to support AP600 plant design certification. This effort will support completing detailed plant design, capital cost estimating and construction scheduling. The design is to meet overall project simplification, economic, and operational goals.

Approach

The conceptual design phase established an HVAC system that allows for a major reduction in components and results in extremely simplified layout and operational requirements. This concept was based on the overall reduction in building volumes, simplified safety requirements as a result of the passive design, and the use of existing building structures as intake and exhaust plenums and distribution paths.

The systems engineering design effort to support NRC Design Certification will focus on the preparation of system descriptions and P&IDs in sufficient detail to support the overall plant and design, including equipment location and duct routing. RAM evaluations will be factored into the design. Detailed analyses and calculations will be performed to establish required heat loads, flow rates and equipment sizing. These will then be confirmed and made final as the duct and piping is physically routed throughout the plant. System I&C design will identify the instrumentation and control requirements to support overall plant I&C integration.

1990 Plan

The 1990 work plan will concentrate efforts on the containment, nuclear island and annex building ventilation systems. No significant work other than that required for interface with building design shall be accomplished for Turbine Building, Access Building and Miscellaneous Ventilation Systems. For the priority HVAC systems the following design milestones will be achieved:

- Review of EPRI Requirements
- Functional Requirements and Design Criteria
- Preliminary System Interface Requirements
- Preliminary System Layout Requirements
- Updated System Documentation

WBS Element 2.2.11 Radioactive Waste Treatment Systems

Responsibility of Westinghouse

Purpose

The purpose of this task is to develop the design of the liquid and gaseous waste processing systems and their components to a design level sufficient to support design certification and to accurately determine the plant cost and construction schedule. Because of the importance of the radioactive waste processing systems to certification, these designs will be developed to a high level of completion. The designs are to meet overall plant simplification, safety, economics, and RAM goals.

Approach

This task will involve the integration of many activities in a systems engineering approach. Generally the process will begin with a review of the designs developed in the AP600 Conceptual Design Program. This review will include inputs from the preliminary NRC review, the EPRI passive plant utility requirements (chapter 12), a value engineering session, and detailed reviews with utilities covering design, operation, and maintenance. Out of this review will come the identification of design issues and formal system design criteria.

The next task will consist of preliminary detailed design efforts which will include optimization studies with parallel safety analysis, RAM analysis, radiation exposure analysis, plant layout, modularization efforts, and cost analysis. During this effort, calculations will be performed to ensure that the design criteria are satisfied. Reviews will be held with equipment vendors to ensure the adequacy of the system requirements and to procure approved-for-layout equipment outline drawings. The resulting detailed system designs will feed information into the design of the instrumentation system, electrical system, plant layout, pipe and cable routings, and modularization, as well as provide updates of the plant cost estimate and construction schedule.

These systems will also undergo formal design reviews at this time. The system designs would than be finalized for the SSAR inputs by factoring in data from tests conducted in the beginning of the Detailed Design and Design Certification Program and additional plant analyses. The SSAR analysis would be based on this update of the systems designs. The AP600 licensing effort will be supported through the preparation of applicable portions of the SSAR chapters 1, 3, 7, 8, 11, and 12.

It is anticipated that as a result of the NRC review of the SSAR and the resolution of their comments, a minor update of the systems documentation will be made at the end of the program for consistency with the FDA.

1990 Plan

The design of the Liquid and Gaseous Waste Processing Systems has an impact upon the plant layout and several other system designs, and is of great interest to plant operators. Therefore, 1990 activities will focus upon the development of more detailed system arrangements and utility and EPRI interfaces.

- Establish Functional Requirements and Design Criteria
- Establish Preliminary System Interface Requirements
- Issue Preliminary System Layout Requirements
- Prepare Updated System Documentation

WBS 2.2.12 Mechanical Handling Systems

Responsibilities of Westinghouse, Bechtel and Southern Company

Purpose

The purpose of this task is to develop the mechanical handling systems to a design level sufficient to support design certification and to determine the plant cost and construction schedule. Under this task, the following systems will be developed:

- Major mechanical handling system for Nuclear Island
- Estimate of material handling equipment in non-Nuclear Island plant

Approach

This task will involve the integration of activities and needs and begin with the designs developed in the AP600 Conceptual Design Program. Early activity will be the identification of design issues and design criteria.

Preliminary design efforts will follow which include interaction with plant performance analysis, RAM analysis, value engineering evaluations, radiation exposure analysis, and plant layout and modularization efforts. During this effort, parameter specifications will be prepared to reflect the functional requirements which include determination of load capacities, load pathways, maximum distances to traverse, and various types of loads to be handled. The resulting designs will be fed back into the design process for plant and equipment layout to ensure loads which require handling during plant operation and maintenance are accommodated in the handling system design and to preserve load carrying pathways. Feedback is also provided to the structural design to ensure the the handling systems' own weight and load capacity can be accommodated. This task interfaces with the hazards analysis for heavy load drop to determine the need for special design features or operating limitations on the mechanical handling systems.

1990 Plan

The 1990 plan will concentrate on the highest priority mechanical handling systems which include the Fuel Handling and Storage System, the In Containment Handling System and the Turbine Island Handling System. Design milestones will concentrate on these three areas and will include the following:

- Review of EPRI Requirements
- Structural Interface Requirements
- Preliminary Layout Requirements
- Preliminary Functional Specifications

WBS Element 2.2.13 Water and Waste Treatment Systems

To be added later.

WBS Element 2.3 Plant Arrangement and Construction Methods

Purpose

The purpose of this WBS element is to provide the plant design details regarding the physical configuration and construction of the plant.

Approach

Physical configuration of the AP600 plant equipment and structures has been established in the AP600 Conceptual Design Program. The detailed design of plant physical configuration will be developed through the design process of routing the piping, cable trays and conduits, and HVAC ducting through the plant structures; identifying and designing piping and equipment modules; designing the mechanical supports to tie plant equipment, piping, cable trays, conduit and duct to the plant structures; and performing the design calculations to verify the mechanical performance of the plant piping and mechanical ties to plant structures.

Other activities associated with the physical configuration of the plant are project and construction plans/schedules, site envelope parameters, architectural features, detailed construction methods and construction capital costs. These activities support design decision making on the plant physical arrangement as well as plant systems and structural design.

1990 Plan

The plant arrangement drawings will be revised to reflect changes in the plant configuration which have resulted from incorporation of EPRI and Utility Steering Committee comments, design changes and optimization studies. 3D CAD modelling will be initiated with a particular emphasis on the initial modelling of the nuclear island. The 3D CAD models will start with the modelling of the structures and the major equipment within the buildings. Continued efforts will be directed toward refining the modularization concepts for the nuclear island and performing the conceptual design of modules in the turbine, annex and access buildings. Construction plans and scheduling effort will concentrate on construction aspects of evaluations of engineering trade studies and preparing detailed logics for selected critical path activities. During 1990 the capital costs will be updated for significant configuration changes which occur in the design.

Major Milestones for 1990 include:

- Complete Preliminary Layout for Nuclear Island
- Issue Revised Plant General Arrangement and Plot Plan
- Create Initial 3D CADD Model of Nuclear Island Structure
- Develop 3D CADD Model Plan
- Develop Module Design Criteria
- Prepare Construction Work Breakdown Structure
- Design Key Nuclear Island Modules
- Update Plant Cost Estimate for Major Changes
- Perform Preliminary Security and Safety Review
- Prepare Construction Logic for Critical Path Activities

WBS 2.3.1 General Arrangement

Responsibility of Westinghouse

Purpose

The AP600 plant general arrangement will be further developed to provide definition to the principal building structures and the equipment arrangements that constitute the AP600 Nuclear Island and Turbine Island complex. Specific design features of the AP600 general arrangement will be based on the overall plant design criteria established for the AP600.

Approach

A preliminary set of general arrangement drawings and a site plot plan for the AP600 have been developed and will be used as a basis for the detailed design. These drawings will demonstrate a plant design that reduces the construction schedule, minimizes construction cost, and meets all safety, operational, maintenance, and structural criteria.

The layout of the general arrangement will interface with all phases of the detailed design process to demonstrate that the objectives of the AP600 are achieved. As the detailed design of the AP600 proceeds, the impact of the design changes will be evaluated with respect to plant layout. This will necessitate that layout studies be conducted to address the impact of any design changes.

Any proposed changes to the AP600 general arrangement will be evaluated to ensure that the design criteria are satisfied by providing:

- Separation of safety and nonsafety systems
- Separation of redundant equipment

- Separation of radioactive and nonradioactive equipment
- Adequate shielding to minimize radiation exposure
- Adequate space for equipment maintenance, laydown, removal, and inspection
- Adequate pathways through the plant to accommodate equipment maintenance and removal

The AP600 general arrangement drawings will continue to be under the configuration control procedure. These procedures ensure that only authorized changes are made to the general arrangement drawings.

1990 Plan

The AP600 General Arrangements will be revised to reflect changes which have resulted from incorporation of EPRI and Utility Steering Committee comments, design changes and optimization studies. The significant milestones associated with the 1990 work are as follows:

- Issue Revised General Arrangement Drawings
- Issue Revised AP600 Site Plot Plan

WBS 2.3.2 Plant Design - Nuclear Island

Responsibility of Bechtel

Purpose

The purpose of this task is to perform the appropriate analyses and design associated with the layout of the piping, HVAC ducting, and cable trays.

This task develops a 3-D CADD (Computer-Aided Drafting Design) model of the Nuclear Island. The routing of piping systems, HVAC ducting, and electrical raceway is determined utilizing the 3-D CADD model. Specifications and codes required analyses are generated to support the layout of these systems.

The extent to which the piping, HVAC ducting and electrical raceway layouts will be performed for each system and for each building will be based on the overall objectives of this task. These objectives are:

- To demonstrate that adequate space is provided for all equipment, piping, ducting and electrical raceway and that adequate space for equipment maintenance, laydown, removal, inspection, and shielding is also provided
- To develop the required piping isometric drawings to support the required piping analyses.
- To develop sufficient data on all quantities to support the overall construction cost estimates and the development of the construction schedule.

Approach

The 3-D CADD model of the structures and detailed routing of the piping, HVAC duct, and raceways will be based on general arrangement drawings, P&IDs, and related plant information. Specifications and design criteria will be developed for piping, HVAC ducts, raceways, and conduit.

Piping stress analyses will be performed to ensure compliance with the ASME B&PV Section III and ANSI B31.1 codes, and NRC regulatory guides. Similar design calculations will be performed for HVAC duct and supports, cable tray, and supports as needed to ensure codes and design requirements are met.

1990 Plan

The 3D CAD modeling effort will be initiated by a controlled process which is founded on a detailed modelling plan. The plan will be used to ensure that the modelling process is effectively used as a design tool on AP600. During 1990 major structures, major equipment and major piping electrical and HVAC

chases will be modelled. The major milestones include:

- Develop Model Plan
- Develop Standard Modelling Procedures
- Model Major Structures
- Model Major Equipment
- Identify Major Chases

WBS 2.3.3 Modularization

Responsibility of Avondale

Purpose

The purpose of the task is to identify modules for detailed design development and perform all appropriate design and analyses for the equipment modules, piping modules and structural modules that will be selected

Approach

Three-dimensional composite drawings of the plant will be developed on a CADD system as part of the layout activity (WBS 2.3.2) to indicate all of the structure, equipment, piping, HVAC ducts and cable trays in each area. By having all systems on one control drawing, the designer can organize the routing of each system and identify equipment and piping suitable for modular construction more efficiently. Equipment modules will be indicated on P&IDs and general arrangement drawings that are specifically designated for this purpose.

Layout drawings will be prepared for the modules, working closely with the CADD composite models. Detail drawings will be individually prepared in booklet form for the modules, and will include a bill of material. Equipment modules will typically include such items as pumps, heat exchangers and filters, mounted in a structural frame, with all of the interconnecting piping, valves and local instruments installed. In some cases, these modules may have piping for various systems, HVAC ducts and cable trays attached to the structural frame. All modules to be fabricated at offsite facilities will be designed to fit within an envelope for standard rail transportation, i.e., 12 by 12 by 80 feet long and 80 tons maximum weight.

The structural frame of the modules will be designed for seismic loads, as well as for lifting and transportation. Lifting arrangement drawings and structural analyses, thermal flexibility analyses for all hot piping and a radiation shielding analysis will be performed. In some cases, a steel plate within the module will be used for shielding.

Specifications will be produced for module fabrication, assembly, shipping, handling, receiving, storage, quality assurance, installation and testing. Cost estimates will be prepared for each module, as well as an overall construction schedule for all modules.

Structural steel modules will be designed to serve as forms for concrete-filled shield walls, free standing tanks, and compartment liners in containment. Outside containment, structural steel modules will be designed for the passive cooling air baffle around containment, the water storage tank in the Shield Building roof, and the fuel pools in the Fuel Handling Building. Since most structural steel modules will be too large for rail transportation, the modules will be designed so that rail-shippable assemblies, or panels, can be built by offsite fabricators and shipped to the site for assembly and outfitting at an onsite facility.

Detailed construction drawings will be developed for each structural module, showing the fabrication details of the assemblies, bill of material, and how the assemblies are erected to form the structural steel modules. Prior to installation, outfitting drawings will be provided to indicate the piping, HVAC ducts, ladders, etc., that attach to the structural steel modules. A lifting arrangement and structural analysis will be provided for each module, and drawings will indicate installation details.

Technical purchase specifications will be provided for the structural steel modules, including fabrication, assembly, shipping, handling and storage, and quality assurance documentation and testing. Cost estimates and an overall construction schedule will be prepared for each module.

1990 Plan

The modularization plan will build upon the successful conceptual designs of the Phase 1 program. Criteria documents will be developed for the major module structural, electrical, and equipment type modules. Interface criteria will be developed between the modules and all major engineering disciplines in the plant design. Module outfitting and testing criteria will be established and several new key nuclear island modules will be designed. Conceptual design decisions regarding the level of modularization will be made for turbine building, annex and access building modules.

- Develop Module Design Criteria
- Develop Module Interface Criteria
- Design Key Nuclear Island Modules
- Conceptualize Modules off the Nuclear Island

WBS 2.3.4 Architectural Features

Responsibility of Bechtel

Purpose

The purpose of this task is to provide the most efficient layout and use of personnel-oriented work stations, and to establish the optimum functional relationships between working entities. In addition, the conceptual plot plan arrangement will be optimized from personnel/material flow and exterior aesthetic perspectives. The plant security and communications systems will be able to support design certification and development of an accurate plant cost and schedule. Specifications will be developed for principal architectural features.

Approach

The overall plant will be reviewed against OSHA, NFPA, and general industry codes and standards. Personnel flow patterns will consist of studies, both during normal plant operations and refueling/maintenance outages, to ensure that personnel are optimizing the use of their time.

The conceptual site plan will be reviewed to establish the proper relationship between structures relative to the flow of personnel and vehicular traffic for operation, maintenance, and security. Orientation of structures, roads, access control points, and parking are included. The overall exterior appearance of the plant will be studied to optimize the use of materials from a maintenance and durability point of view, and to ensure that proper architectural features are integrated into the design to enhance the aesthetic appearance. Interior architectural design features and related specifications will be developed to the level necessary to support design certification.

Design criteria and detailed designs for the plant security and communications systems will be developed. These designs will feed information into the design of the electrical system, control room, plant layout, cable routing, and modularization, as well as provide updates of the plant cost and schedule. The component designs will be finalized for the SSAR.

1990 Plan

Architectural design will be limited to:

- Review of Nuclear Island design concepts for conformance to OSHA
- Development of project architectural standards for design

WBS 2.3.5 Site Envelope

Responsibility of Bechtel

Purpose

Site envelope criteria will be established for the design of the AP600 to develop parameters that characterize the majority of available sites in the continental United States.

Approach

A study will be performed of the site conditions of nuclear power plants located within the continental United States. Final Safety Analysis Reports (FSARs) will be reviewed to obtain the necessary information, with additional information being obtained as required from owner-utilities. Possible additional sites will be considered. In addition, previous studies of this nature performed by other organizations will be evaluated. Based on this study, the parameter envelopes to be used in the design of the AP600 will be finalized. Extreme conditions that would have a high cost impact and affect only a very limited number of sites will be excluded.

1990 Plan

The site envelope definition will parallel the detailed design effort. As additional environmental data is required for detailed design in areas such as seismic design and cooling system design, additional general site parameters will be defined in greater detail. Major milestones include:

- Review EPRI Requirements and AP600 Phase 1 Site Envelope Requirements
- Provide additional parameters for cooling system and seismic designs

WBS 2.3.6 First Unit Project Plan & Schedule

Responsibility of MK-Ferguson and Westinghouse

Purpose

The purpose of this task is to develop a schedule that integrates the site-specific engineering procurement, construction, and startup of the first unit ordered. In addition, the task will address the procurement lead times of the major equipment and modular components, and formulate the optimum system turnover/startup sequence.

Approach

Using the 36-month construction schedule as a base, we will determine the required start dates for the site-specific engineering and procurement activities. Site-specific engineering durations will be based on common variables that will not require unusual engineering solutions. Procurement and module lead times will be developed for major equipment and unique material, by contacting likely suppliers – both domestic and abroad. System turnover/ startup will be based on construction sequence and will consider modular construction. The integrated schedule will be prepared on a computerized schedule processor.

1990 Plan

A review of the construction schedule will be accomplished with an objective of identifying critical long lead time material requirements and modules. Only likely critical path items will be addressed in 1990.

WBS 2.3.7 Construction Plan and Schedule

Responsibility of MK-Ferguson

Purpose

A major AP600 program objective is preparation of a comprehensive construction plan and detailed construction schedule. The construction plan will detail an orderly sequence of specific work activities, thereby optimizing scheduling, eliminating

confusion during construction, and providing specific construction direction. Construction planning will provide the process that allows constructability review to be incorporated into the detailed design. The AP600 construction planning process will also include identification and quantity development of all construction labor, equipment and material resources to be included in a detailed schedule and construction cost estimate. These resources will consist of construction equipment planning and scheduling, craft labor hours, material quantities, direct and indirect labor and productivity unit rates. This process will be development of a complete CWBS, logic diagramming, determination of activity durations, productivity factoring, all of which will be computerized for detailed scheduling, cost estimating and providing "what if" network logic analysis for contingency planning and scheduling. The purpose of these efforts is to develop an accelerated shorted schedule and a plant that can be constructed for less cost.

Approach

CR will be an integral element of construction planning during the detail design phase, as recommended by EPRI, the DOE ALWR Constructibility Program, and the Business Round Table. CR becomes the basis for preparing a comprehensive construction plan and developing an achievable construction schedule.

These studies will include review of design concepts, drawings and technical specifications, as well as determination of the most advantageous productive/schedule construction sequences, methods and techniques. Detailed evaluation of new and faster ways of construction as well as applicability of "modularization" to every segment of AP600 construction will be included.

The specific studies will also provide a detailed construction schedule which will identify major construction work activities and resources. The schedule results are to ensure verification of specific activity durations. Detailed studies will include:

- AP600 construction methods and techniques
- Construction equipment requirements (cranes, pumps, etc.)
- Concrete supply facilities
- Temporary site infrastructure
- Nuclear island construction
- Turbine island construction
- Balancing of plant construction
- Construction progress and control system

The construction schedule will be developed on the network analysis system utilizing the ARTEMIS (TECS2) Computer System. This sequencing system and construction logic networking will be applied to all major activities such as:

- Nuclear Island
  - Auxiliary Building
  - Fuel Handling Building
  - Shield Building
  - Containment structure
  - Annex Building
- Turbine Island
  - Turbine Building basemat
  - Turbine generator pedestal
- Balance of plant structures
  - Access Control Building
  - Diesel Generator Building
  - Solid Radwaste Building
- Mechanical, electrical, HVAC and instrumentation installation
- NSS component installation
- Equipment and structural module sequencing
- System startup
- Fuel loading

This program will be developed by preparing a CWBS that will be the basis to identify and quantify all major elements, components, tasks and necessary resources to perform the work activities.

The CWBS, logic networking, durations, production unit rates and resources will be developed into the AP600 Construction Baseline Control Schedule. These elements will further provide the basis for development of a progress/control monitoring system. (Integrated cost/schedule/control system).

Materials management program criteria will be developed in conjunction with a materials/equipment schedule and statusing system. This program will use data from the construction schedule and cost/schedule control program. It will identify program requirements for procurement, receiving, inspection, storage, handling inventory control and in-storage preventative maintenance of materials and equipment.

Other major areas of the construction plan and schedule will include:

- Modular construction applications
  - Module identification, installation, interface tracking and detailing, and installation methods.
- Constructibility concrete composite placement drawing detail requirements

CR and evaluation of productive construction methods will be incorporated into the design process. All major AP600 plant construction elements and major milestones will be planned in detail. As shown in Figure 3-1, all of these elements will be evaluated, so that the most productive methods for producing a shorter construction schedule and minimizing costs can be included.

1990 Plan

The construction plan will concentrate on developing a Construction Work Breakdown Structure which is consistent with the program numbering system as well as providing additional detailed schedule construction logic and planning for key activities that are candidates for the critical path (containment interior concrete, fuel building liners, etc.). In addition, trade off studies will be accomplished in support of various engineering alternatives. Major milestones include:

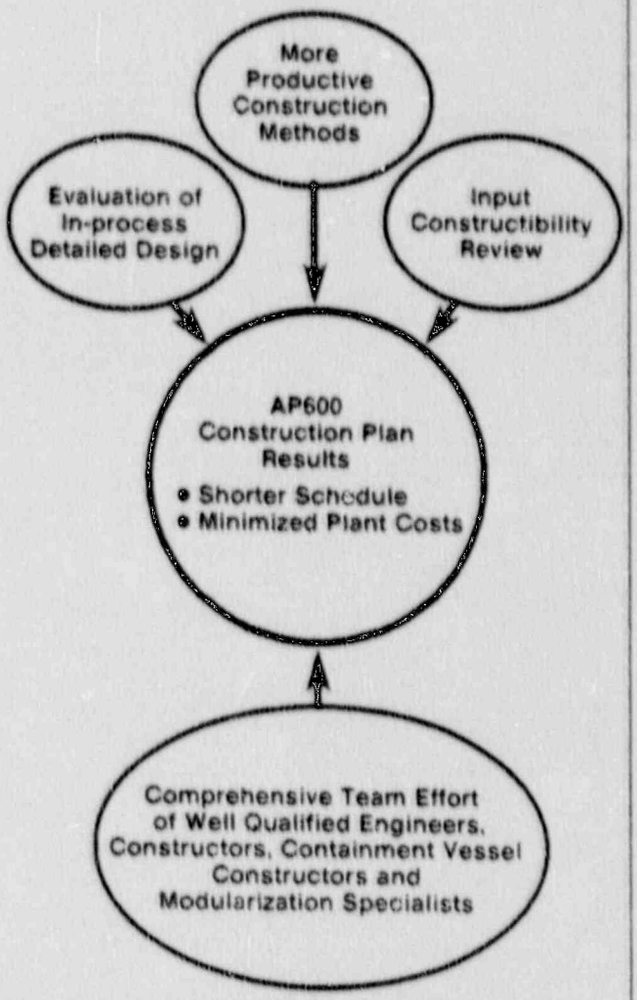


FIGURE 3-1. COMPREHENSIVE AP600 CONSTRUCTION PLANNING PROCESS: This process produces short 36-month schedule for less cost.

- Prepare Construction Work Breakdown Studies
- Prepare Logic for Selected Critical Path Activities
- Support Engineering Trade Studies with Construction Impact Evaluations

WBS 2.3.8 Construction Methods

Responsibility of MK-Ferguson

Purpose

The purpose of construction methods evaluation will be to further investigate and apply more productive and cost effective construction techniques to the AP600 detailed design. This task is to identify and determine the feasibility of applying new methods which have not historically been used in construction of nuclear power plants. Some of these methods may have been used previously on a limited basis. The cost impact of new or different construction methods must be weighed to determine productivity and schedule success. All high cost critical areas of construction such as the following will be evaluated:

- Concrete forming
- Concrete placement
- Rebar detailing fabrication and installation
- Structural steel erection
- Piping installation
- Multiple discipline hangers or supports, pipe racking, etc. will be continuously applied to the in-process design activities
- Mechanical/electrical component installation

Approach

Integrating new construction methods into the AP600 detailed design will be performed by a review team with extensive design engineering and construction expertise. Standardization and suitability of various practices will be an ongoing process during construction planning. Several construction practices to be incorporated into the AP600 are:

- On site pre-assembly
- Modularization
  - Structural steel modules
  - Leave-in-place formwork
  - Steel shoring modules versus stick built
  - Conventional shoring
- Precast components
- Spring supported turbine operating deck
- Large component assembly (steel containment liner)
- Offsite fabrication
- Prefabrication of rebar modular assemblies
- Large monolithic concrete placement
- Gang paneled concrete form
- Jump forming
- Combination equipment, piping, cable tray and HVAC modules
- Adverse weather protection
- Load indicator structural steel bolts
- Advanced welding technologies (automatic versus manual)
- Advanced laser survey methods
- Rebar lap splices versus mechanical splicing
- Leave-in-place expanded metal formwork bulkheads

The major construction method approach used for the AP600 will be modularization concepts previously applied in other industry work such as shipbuilding and petrochemical plants.

1990 Plan

Construction methods will be evaluated which match most closely with the significant design efforts for 1990. Methods associated with the civil and structural construction activities, particularly within the nuclear island, will be investigated and selected. A close interface will be maintained with the design effort to ensure consistency of design with the methods selected.

WBS 2.3.9 Capital Cost Estimate

Responsibility of MK-Ferguson

Purpose

A detailed preliminary capital cost estimate will be developed for construction of the AP600 plant in

accordance with DOE/NE0092, "DOE Energy Economics Database Code of Accounts." The cost estimate is to be based on the results of the Detailed Design and Design Certification Program with sufficient detail and accuracy to confirm the competitive cost of the simplified passive design of the AP600 plant.

Approach

Direct costs will be developed on a substantially completed design, with well defined quantities of equipment, components and bulk quantities. Equipment and component costs developed during the AP600 Conceptual Design Program will be reviewed and updated as required to reflect the detailed design and current vendor cost information. Construction labor and productivity estimates will also be reviewed and upgraded to ensure that they accurately reflect the current construction labor market. Particular attention will be given to the impact of modularized fabrication and construction techniques detailed during this phase. Costs of prefabricated modules, shipping, and installation will be developed and will replace the "stick construction" costs on which the current cost estimate is based.

Indirect costs will be developed on conservatively-based historical cost relationships, but will take into account the unique design and construction approach associated with the AP600 design. This will include the impact and indirect costs associated with a much simplified design, modular fabrication and construction concepts, and a completed engineered and designed plant prior to the start of construction. Indirect costs will also be presented on a three-digit code-of-account level of detail.

1990 Plan

No major update of the Phase I Capital Cost Estimate is envisioned in 1990. Major changes effecting the cost estimate will be itemized and their effects will be estimated. Cost estimate efforts in 1990 will concentrate on supporting engineering "trade" studies with sufficient quality cost information to contribute to informed engineering decisions.

WBS Element 2.3.10 Plant Design - Turbine Island

Responsibility of Southern Company

Purpose

The purpose of this task is to perform the appropriate analyses and design associated with the layout of the piping, HVAC ducting, and cable trays.

This task develops a 3-D CADD (Computer-Aided Drafting Design) model of the Turbine Island. The routing of piping systems, HVAC ducting, and electrical raceway is determined utilizing the 3-D CADD model. Specifications and codes required analyses are generated to support the layout of these systems.

The extent to which the piping, HVAC ducting and electrical raceway layouts will be performed for each system and for each building will be based on the overall objectives of this task. These objectives are:

- To demonstrate that adequate space is provided for all equipment, piping, ducting and electrical raceway and that adequate space for equipment maintenance, laydown, removal, inspection, and shielding is also provided.
- To develop the required piping isometric drawings to support the required piping analyses.
- To develop sufficient data on all quantities to support the overall construction cost estimates and the development of the construction schedule.

Approach

The 3-D CADD model of the structures and detailed routing of the piping, HVAC duct, and raceways will be based on general arrangement drawings, P&IDs, and related plant information. Specifications and design criteria will be developed for piping, HVAC ducts, raceways, and conduit.

Piping stress analyses will be performed to ensure compliance with the ANSI B31.1 codes. Similar design calculations will be performed for HVAC duct and supports, cable tray, and supports as needed to ensure codes and design requirements are met.

1990 Plan

The 3D CAD modeling effort will be initiated by a controlled process which is founded on a detailed modelling plan. The plan will be used to ensure that the modelling process is effectively used as a design tool on AP600. The major milestones include:

- Develop Model Plan
- Develop Standard Modelling Procedures
- Develop Building Outline Drawings

WBS Element 2.3.11 Plant Design - Annex Building

Responsibility of Burns and Roe.

Purpose

The purpose of this task is to perform the appropriate analyses and design associated with the layout of the piping, HVAC ducting, and cable trays.

This task develops a 3-D CADD (Computer-Aided Drafting Design) model of the Annex Building. The routing of piping systems, HVAC ducting, and electrical raceway is determined utilizing the 3-D CADD model. Specifications and codes required analyses are generated to support the layout of these systems.

The extent to which the piping, HVAC ducting and electrical raceway layouts will be performed for each system and for each building will be based on the overall objectives of this task. These objectives are:

- To demonstrate that adequate space is provided for all equipment, piping, ducting and electrical raceway and that adequate space for equipment maintenance, laydown, removal, inspection, and shielding is also provided.
- To develop the required piping isometric drawings to support the required piping analyses.
- To develop sufficient data on all quantities to support the overall construction cost estimates and the development of the construction schedule.

Approach

The 3-D CADD model of the structures and detailed routing of the piping, HVAC duct, and raceways will be based on general arrangement drawings, P&IDs, and related plant information. Specifications and design criteria will be developed for piping, HVAC ducts, raceways, and conduit.

Piping stress analyses will be performed to ensure compliance with the ANSI B31.1 codes. Similar design calculations will be performed for HVAC duct and supports, cable tray, and supports as needed to ensure codes and design requirements are met.

1990 Plan

The 3D CAD modeling effort will be initiated by a controlled process which is founded on a detailed modelling plan. The plan will be used to ensure that the modelling process is effectively used as a design tool on AP600. The major milestones include:

- Develop Model Plan
- Develop Standard Modelling Procedures
- Develop Building Outline Drawings

WBS Element 2.3.12 Plant Design - Radwaste Building

Responsibility of Burns and Roe.

Purpose

The purpose of this task is to perform the appropriate analyses and design associated with the layout of the piping, HVAC ducting, and cable trays.

This task develops a 3-D CADD (Computer-Aided Drafting Design) model of the Radwaste Building. The routing of piping systems, HVAC ducting, and electrical raceway is determined utilizing the 3-D CADD model. Specifications and codes required analyses are generated to support the layout of these systems.

The extent to which the piping, HVAC ducting and electrical raceway layouts will be performed for each system and for each building will be based on the overall objectives of this task. These objectives are:

- To demonstrate that adequate space is provided for all equipment, piping, ducting and electrical raceway and that adequate space for equipment maintenance, laydown, removal, inspection, and shielding is also provided.
- To develop the required piping isometric drawings to support the required piping analyses.
- To develop sufficient data on all quantities to support the overall construction cost estimates and the development of the construction schedule.

Approach

The 3-D CADD model of the structures and detailed routing of the piping, HVAC duct, and raceways will be based on general arrangement drawings, P&IDs, and related plant information. Specifications and design criteria will be developed for piping, HVAC ducts, raceways, and conduit.

Piping stress analyses will be performed to ensure compliance with the ASME B&PU Section III and ANSI B31.1 codes, and NRC regulatory guides. Similar design calculations will be performed for HVAC duct and supports, cable tray, and supports as needed to ensure codes and design requirements are met.

1990 Plan

The 3D CAD modeling effort will be initiated by a controlled process which is founded on a detailed modelling plan. The plan will be used to ensure that the modelling process is effectively used as a design tool on AP600. The major milestones include:

- Develop Model Plan
- Develop Standard Modelling Procedures
- Develop Building Outline Drawings

WBS Element 2.3.13 Plant Design - Pumphouse and Cooling Towers

Responsibility of Southern Company

Purpose

The purpose of this task is to perform the appropriate analyses and design associated with the layout of the piping, HVAC ducting, and cable trays.

This task develops a 3-D CADD (Computer-Aided Drafting Design) model of the Circulating Water Pumphouse and Cooling Tower. The routing of piping systems, HVAC ducting, and electrical raceway is determined utilizing the 3-D CADD model. Specifications and codes required analyses are generated to support the layout of these systems.

The extent to which the piping, HVAC ducting and electrical raceway layouts will be performed for each

system and for each building will be based on the overall objectives of this task. These objectives are:

- To demonstrate that adequate space is provided for all equipment, piping, ducting and electrical raceway and that adequate space for equipment maintenance, laydown, removal, inspection, and shielding is also provided.
- To develop the required piping isometric drawings to support the required piping analyses.
- To develop sufficient data on all quantities to support the overall construction cost estimates and the development of the construction schedule.

Approach

The 3-D CADD model of the structures and detailed routing of the piping, HVAC duct, and raceways will be based on general arrangement drawings, P&IDs, and related plant information. Specifications and design criteria will be developed for piping, HVAC ducts, raceways, and conduit.

Piping stress analyses will be performed to ensure compliance with the ANSI B31.1 codes. Similar design calculations will be performed for HVAC duct and supports, cable tray, and supports as needed to ensure codes and design requirements are met.

1990 Plan

The 3D CAD modeling effort will be initiated by a controlled process which is founded on a detailed modelling plan. The plan will be used to ensure that the modelling process is effectively used as a design tool on AP600. The major milestones include:

- Develop Model Plan
- Develop Standard Modelling Procedures
- Develop Building Outline Drawings

WBS Element 2.3.14 Plant Design - Misc Buildings

Responsibility of Southern Company

Purpose

The purpose of this task is to perform the appropriate analyses and design associated with the layout of the equipment, piping, HVAC ducting, and cables in the miscellaneous buildings.

This task develops the outline drawings, bill of materials, and support services requirements for the Miscellaneous Buildings in details sufficient to complete the site plan, cost estimate and design of the support services.

The objectives of this task are:

- To demonstrate that adequate space is provided for intended activities.
- To develop sufficient data on all quantities to support the construction cost estimate and schedule.
- To develop sufficient data to support the design of the plant auxiliary systems such as domestic water, sewage, lighting, communication, etc.

Approach

Outline drawings and other required data will be prepared based on the related plant information and previous designs for similar nuclear plants.

1990 Plan

- Develop Outline Drawings

WBS Element 2.4 Structural Design and Analysis

Purpose

This WBS element provides for the detailed design of

the plant structures.

Approach

Initial design definition of AP600 plant structures has been developed as part of the AP600 Conceptual Design Program. These initial structural designs will be developed into detailed designs according to detailed structural design criteria and general construction specifications to be developed early in the program. Detailed design of the plant structures will be carried out according to established design practices including seismic analysis of the Nuclear Island structures. The detailed structural designs will be verified against the appropriate structural design criteria.

1990 Plan

The structural design efforts will concentrate on the Nuclear Island. A general structural design criteria will be established for all structures and an individual criteria will be developed for each major building. The structural design of the nuclear island will commence with a seismic analysis of the structure and will include preliminary structure module and steel framing sizing and design. For the turbine building an evaluation of a spring mounted turbine foundation will be conducted and a basic decision will be reached regarding the turbine building structure. A preliminary structural design of the annex and access building will be conducted in order to select the type of structure to be employed in that building. Major milestones include:

- Issue Initial Seismic Analysis
- Develop Structural Design Criteria
- Establish the Seismic Analysis Method
- Establish Soil Conditions to be Analyzed
- Develop Nuclear Island Seismic Model
- Develop Preliminary Nuclear Island Concrete Outline Drawings
- Develop Preliminary Nuclear Island Structural Module and Steel Framing Design
- Select Turbine Foundation Type
- Issue Preliminary Turbine Building Steel Framing Drawings
- Select Structure Type for Annex and Access Building

WBS Element 2.4.1 Structural Design Criteria

Scope moved to 2.1.3.

WBS Element 2.4.2 General Construction Specifications

Scope moved to 2.1.4.

WBS 2.4.3 Seismic Analysis

Responsibility of Bechtel

Purpose

The purpose of this task is to perform the seismic analysis of the Nuclear Island structures.

Approach

The seismic categories identified for the AP600 plant design are Seismic Category I and non-Seismic Category I.

Seismic studies will be performed for the Seismic Category I Nuclear Island structures to obtain representative bounding seismic inertia loads, seismic building displacements, and floor response spectra required for the seismic design of structures, key equipment, systems, components, and piping. The studies will also result in a set of seismic design parameters that can be used to compare the corresponding parameters from site-specific studies, to confirm the applicability of the AP600 standardized design for the site-specific foundation soil condition and seismic environment. To carry out the studies, seismic analyses will be performed for the Nuclear Island structures. Design seismic inputs will be developed for seismic analysis use in the form of three-component synthetic acceleration time

histories. These will be compatible with the design ground motion response spectra. Three-dimensional lumped-mass stick models that are appropriate for seismic response analyses will be developed for structures comprising the Nuclear Island. The analyses will be performed for the SSE.

The safe shutdown earthquake (SSE) and operating basis earthquake (OBE) criteria for the AP600 plant are 0.30G and 0.1G respectively. The magnitude of the OBE has been defined independently of the SSE. The OBE will be used primarily as a design basis to protect the utilities' investment. The SSE will be limiting and will define the seismic and foundation conditions for the plant.

The appropriateness of Regulatory Guide 1.60 response spectra for application to AP600 generic design will be reviewed in view of the recent studies on seismic hazards performed by Lawrence Livermore National Laboratory and EPRI.

Seismic analyses will consider the effects of soil-structure interaction effect. The analyses will utilize state-of-the-art approaches that are expected to become standard industry practice in the future. To enhance reliability and licensibility, confirmation analyses using an equivalent but independent approach will be performed for selected cases. To ensure applicability of the standard design for a wide variety of sites, seismic soil-structure interaction analyses will consider at least three generic site conditions, namely; soft soil (V_s = 1000 fps for the surface soil layer overlaying rock at some depth), firm soil/soft rock (V_s = 2000 to 3000 fps increasing with depth) and hard rock (V_s = 6000 fps uniformly). The foundation stratifications for the three generic site conditions will be selected from representative existing nuclear plant sites. To be realistic, the embedment effect will be considered in the seismic soil-structure interaction analysis. The factor of safety for seismic sliding and overturning stability will be evaluated. The static and dynamic soil bearing requirements will also be established and special foundation design consideration for soft soil sites will be recommended.

For non-Seismic Category I structures, seismic analysis will be performed for SSE to obtain the seismic inertia loads required for the structural design to ensure that the structures do not collapse and endanger the adjacent Seismic Category I structures. Seismic displacements are also necessary for evaluation of the impact on the adjacent Seismic Category I structures.

1990 Plan

Seismic analysis of the nuclear island structure is a major program deliverable for 1990. Major milestones related to this task include:

- Establish the Soil Conditions to be Analyzed
- Develop Nuclear Island Seismic Model

WBS 2.4.4 Nuclear Island Structures

Responsibility of Bechtel

Purpose

The purpose of this task is to perform the appropriate analyses and design for the Nuclear Island structures and to prepare the appropriate structural definition drawings. Structures under this task include the Nuclear Island basemat, containment structures, Shield Building, Fuel Handling Building, and the Auxiliary Building. The containment interior structures and the air baffle structure comprise the containment structures.

Approach

The structural analysis and design will be based on the industry codes, standards, specifications, NRC regulatory guides and other requirements specified in the design criteria and safety analysis report for Seismic Category 1 structures. The analysis and design will account for all anticipated loadings and

postulated conditions that may be imposed on the structures, including the SSE, tornado effects and postulated design basis accident loads.

Seismic analysis will be performed as described in WBS 2.4.3.

The design of the structural steel modules that will be utilized as shear walls and forms for a major portion of the containment interior structure is described in WBS 2.3.3. Studies will be performed to develop optimum design criteria and techniques to account for stiffness of the structural steel modules. Appropriate testing will be conducted as described in WBS 2.6.10.4. The other structures in the Nuclear Island are of typical reinforced concrete construction utilized in nuclear power plant construction. Therefore, the design will not require development of new technology.

1990 Plan

The structural design of the nuclear island structure will proceed in parallel with the seismic analysis. The preliminary structural design should be completed in 1990 with the following associated milestones:

- Preliminary Concrete Outline Drawings
- Preliminary Structure Module and Steel Framing Design

WBS Element 2.4.5 Containment Vessel

Responsibility of CBI Services

Purpose

The purpose of this task is to perform all appropriate analyses and design for the containment vessel and to prepare the appropriate structural definition drawings. This task includes the free standing, carbon steel, cylindrical containment vessel, the main equipment hatch, the personnel hatch, the emergency egress hatch, penetrations, and the polar crane girder that attaches to the upper ring section of the containment vessel.

Approach

The design specification for the containment vessel will be in accordance with the requirements of ASME, Section III, Division I, Subsection NE. Containment specifications will be prepared for the procurement, welding, manufacturing, construction, fabrication/assembly, shipping and handling, receiving and storage, and quality assurance.

The containment structure is to be designed for modular construction. The modular design for this structure consists of five large structural sections: the bottom head, the lower ring section, the middle ring section, the upper ring section, and upper head. The modular sections will be designed for offsite fabrication of large rail shippable pieces that would be assembled into the five modular sections at an onsite fabrication facility.

Erection facilities/equipment drawings and requirements will be prepared for the temporary foundations, temporary columns, subassembly supports, preheat equipment, crane utilization, lifting arrangements, temporary stiffening, weather protection, vessel test arrangement, and utilities.

Schedules will be developed for all phases of the containment vessel fabrication/assembly/construction which would include design/engineering, procurement, manufacturing, shipping, construction, and testing.

1990 Plan

- Initial containment vessel design calculations and drawings will be developed.
- Specific procedures for containment vessel nondestructive examination and welding will be developed to support design and fabrication planning.

- Initial sections of the containment vessel design report will be developed.

WBS 2.4.6 Turbine Island Structures

Responsibility of Southern Company

Purpose

The purpose of this task is to perform the appropriate analyses and design for the Turbine Island and to prepare the appropriate structural definition drawings. This task includes the structural design for the Turbine Building, the Turbine Building basemat and the Turbine pedestal.

Approach

The structural analysis and design will be based on the industry codes, standards, specifications, NRC regulatory guides and other requirements specified in the design criteria and safety analysis report. The analysis and design will account for all anticipated loadings and postulated conditions that may be imposed on the structures.

Seismic analysis will be performed as described in WBS 2.4.3 for non-Seismic Category I structures.

The Turbine Island structures are typical structural steel and reinforced concrete structures utilized in nuclear power plant construction. Therefore, the design will not present unusual problems or require development of new technology.

1990 Plan

In 1990 the conceptual structural design of the turbine island will be accomplished. An evaluation of spring mounted turbine foundation will be accomplished and a selection made regarding the type of turbine foundation. Sufficient preliminary structural design will be accomplished to support the building layout issues. The following milestones will be accomplished:

- Establish Design Criteria
- Select Turbine Foundation Type
- Preliminary Steel Framing Drawings
- Preliminary Concrete Outline Drawings

WBS 2.4.7 Annex Building Structures

Responsibility of Burns and Roe

Purpose

The purpose of this task is to perform all the appropriate analyses and design for the Annex Building structures and to prepare the appropriate structural definition drawings.

Approach

The structural analysis and design will be based on the industry codes, standards, specifications, NRC regulatory guides and other requirements specified in the design criteria and safety analysis report. The analysis and design will account for all anticipated loadings and postulated conditions that may be imposed on the structure.

Seismic analysis for the Annex Building, the first floor of which is designated as Seismic Category I, will be performed as described in WBS 2.4.3. The seismic analysis for the upper floor levels of the Annex Building will be performed as described in WBS 2.4.3 for non-Seismic Category I structure.

The Annex Building is a typical reinforced concrete structure utilized in nuclear power plant construction. Therefore, the design will not present unusual problems or require development of new technology.

1990 Plan

Only preliminary structural designs of the annex buildings will be performed in 1990. The objectives of the structural design will include an evaluation of

the building structure type (steel frame versus reinforced concrete) and sufficient structural design to ensure that building layout interfaces are accomplished. Task milestones include:

- Establish Building Structural Design Criteria
- Select Type of Structure
- Perform Preliminary Structural Analysis
- Develop Preliminary Steel Framing Drawings

WBS 2.4.8 Solid Radwaste Building Structures

Responsibility of Burns and Roe

Purpose

The purpose of this task is to perform the appropriate analyses and design for the Solid Radwaste Building and to prepare the appropriate structural definition drawings. The design will be completed in sufficient detail to ensure that established criteria are met and to support completion of detailed plant layout, capital cost estimating, and construction scheduling.

Approach

The Solid Radwaste Building will be designed to house the solid waste processing system, waste handling equipment, the hot machine shop, and decontamination facilities. It will also provide for temporary storage of radioactive wastes prior to offsite disposal.

The building will be designed as a non-Seismic Category I structure. Shielded areas with concrete walls and roof will provide radiation protection for truck access and radioactive waste storage. The balance of the building will be a steel frame structure with steel siding and roofing. Internally, the control room and solid waste processing area will be shielded by concrete walls and ceilings.

1990 Plan

No activity is planned.

WBS 2.4.9 Diesel Generator Building Structures

Included in 2.4.7.

WBS 2.4.10 Access Control Building Structures

Included in 2.4.7.

WBS 2.4.11 Circulation Water Pump House Structure

Responsibility of Southern Company

Purpose

The purpose of this task is to perform the appropriate analyses and design for the Circulating Water Pump House and related structures, including the cooling tower basin and chlorination building. The design will be completed in sufficient detail to ensure that established criteria are met and to support completion of detailed layout design, capital cost estimating, and construction scheduling.

Approach

The structural design will be performed in accordance with the criteria for AP600 nonsafety structures. The circulating water pump house will be designed as a steel frame structure with steel siding and roofing, reinforced concrete foundations, and pump pits. Each of the two pump bays will be provided with a double row of separately fixed screens. The cooling tower basin will be connected to the pump pits and consist of the pump basin and four canals. The basin will be designed as a below grade structure, with a reinforced concrete floor and walls. Stop logs will be provided near the pump basin.

The chlorination building will be designed as a one story steel frame structure with steel siding and roofing and a reinforced concrete foundation.

1990 Plan

Conceptual work associated with the selection of the cooling tower type for AP600 will be done. A conceptual layout of the structure will be completed.

WBS 2.4.12 Miscellaneous Structures

Responsibility of Southern Company

Purpose

The purpose of this task is to perform preliminary design for the following miscellaneous structures:

- Switchyard
- Gas storage tanks/structures
- Administrative building
- Security building
- Warehouse
- Fire pump house

The preliminary designs will be completed in sufficient detail to ensure that criteria and interface requirements are met and to support the plant general arrangement, site plot plan, capital cost estimating, and construction scheduling tasks.

Approach

The design will be based on the AP600 criteria for non-Seismic Category I structures.

The switchyard will be designed as a reinforced concrete foundation for vendor-furnished equipment and will include grading of the switchyard area and fence design.

Foundations for the gas storage tanks will be designed using reinforced concrete adequate to support an evaporator, and nitrogen, hydrogen, and CO_2 storage tanks.

The security and warehouse structures will be designed using reinforced concrete foundations for prefabricated steel buildings.

The fire pumphouse will be designed as a one-story steel frame structure with steel siding on a reinforced concrete foundation.

The administrative building will be designed as a concrete block building, with a steel frame and steel roofing on a reinforced concrete foundation.

1990 Plan

No activity is planned.

WBS Element 2.5 Plant Analysis and Requirements

Purpose

Plant level analyses support other detailed design efforts or design certification activities.

The analyses result in the following reports:

- Protection system functional analysis
- Control system functional analysis
- RCS design transient analysis
- Shielding and radiation analysis
- Plant hazards analyses
- Emergency operation analysis

Approach

The plant level functional analyses provide the plant response information necessary to perform the detailed design of the plant control and protection portions of the I&C systems.

The finalized control system design will contain generic setpoints that have been exposed to a series of calculations that exercise the controllers over the entire power range and over a range of key core parameters (moderator temperature and doppler

coefficients), and control rod worths that reflect the expected variations throughout the entire fuel cycle.

The finalized protection system design will contain generic setpoints that have been exposed to a series of calculations that exercise the protection system over a wide range of core parameters and over all the Design Basis Transients.

The RCS design transients analyses provide the transient pressure and temperature curves and cycles needed for the detailed mechanical design of the primary system components.

The RCS design transients are time history plots of pressure, temperature and flow for all the events that the plant is expected to experience. In addition, there are specifications of the anticipated number of occurrences for each event.

The RCS design transients are generated using normal design and analysis codes. For the major part, they are best estimate analyses with some degree of conservatism

Shielding and radiation analyses provide the radiation environment information for detailed shielding design, equipment design and occupation radiation exposure evaluation.

Normal operating sources are based on plant design features and applicable data from operating plants. These sources are employed in environmental analyses and evaluations where operating conditions over the life of the plant are used.

Post-accident sources for a broad spectrum of accident scenarios are calculated and used in shield designs to protect the public and plant personnel from the radiation released to the containment building or to the plant evirons.

The shielding requirements are integrated with structural and layout requirements to arrive at the optional configuration for the components of the various shielding groups.

The hazards analyses provide information to support detailed design of plant structures, systems and equipment to withstand natural and plant-related hazards and support design certification documentation of plant ability to withstand these hazards. Hazards associated with such events as pipe rupture, tornado, fire, heavy load drop, or flood are evaluated to determine potentially unacceptable consequences to structure and systems important to safety.

The results of each evaluation of the impact on structures and systems important to safety will be fed back into the design process for structural and system designs to ensure that protection requirements are met or exceeded for structures and systems important to safety. The criteria for acceptance of the hazard conditions is the availability of the minimum number of systems and equipment necessary to safely shutdown the plant.

Emergency operation analyses provide information to support detailed design of plant systems and to support design certification documentation of the plant's ability to respond to emergency situations.

The program for developing AP600 design specific guidelines will utilize the Westinghouse Owner's Group Emergency Response Guideline (ERG) framework which has been approved by the NRC for implementation at existing Westinghouse PWRs.

The guidelines will provide prioritized operator guidance for recovering the plant from an emergency transient, while at the same time ensuring that the plant safety state is explicitly monitored and maintained during recovery.

The guidelines will be verified to ensure their applicability to the control room design. The program tests both the technical and human factor adequacy of the guidelines

1990 Plan

- Develop preliminary functional requirements and preliminary functional diagrams for Protection and Control Systems
- Establish specific bases for design transients
- Develop the AP600-specific LOFTRAN thermal/hydraulic computer code model
- Develop source terms for various plant conditions
- Develop preliminary radiation zoning diagrams
- Confirm Shielding Configuration for Major Structures
- Develop Design Criteria for Hazards
- Develop Design Guides to Minimize Impact of Hazards
- Establish a framework for preparation of the Emergency Operating Procedures
- Develop specific high level response strategies for a set of emergency events

WBS Element 2.5.1 Protection System Functional Analysis and Requirements

Responsibility of Westinghouse

Purpose

The purpose of this activity is to develop the functional design of the NSSS protection systems and to demonstrate that the protection system designs will meet the Design Basis Transient response requirements stipulated in the AP600 design basis specifications. The transients considered include Condition I, II, III and IV events caused by increases or decreases in heat removal by the secondary side, decreases in reactor coolant system flowrate, reactivity and power distribution anomalies, and increases or decreases in reactor coolant system inventory. The protection systems will be engineered to the level of function requirements and diagrams. This will provide a clear definition of the protection systems for the certification process and a firm basis for estimates and schedules in the procurement design phase.

Approach

The design of the NSSS protection systems (reactor trip functions and engineered safeguards features actuation functions) is an iterative process involving conceptualization, modeling, model and setpoint evaluations, and performance analyses.

The AP600 protection systems will proceed through two levels of design review before documentation for certification is completed. The finalized design will contain generic setpoints that have been exposed to a series of calculations that exercise the protection system over a wide range of core parameters and over all the Design Basis Transients.

1990 Plan

Issue preliminary functional diagrams and requirements.

WBS Element 2.5.2 Control System Functional Analysis and Requirements

Responsibility of Westinghouse

Purpose

The purpose of this activity is to develop the functional design of the NSSS control systems and to demonstrate that the controller designs will meet the normal operational transient response requirements stipulated in the AP600 design basis specifications. The normal operational transients include ±10 percent step changes, day/night cycling (load follow) without changing the RCS boric acid concentration, load rejections, and remotely dispatched economic generation control. The control systems will be engineered to the level of functional requirements and diagrams. This will provide a clear definition of the NSSS controllers for the certification process and

a firm basis for estimates and schedules in the procurement design phase.

Approach

The design of the major NSSS control systems (pressurizer pressure and level, steam generator level, steam dump, reactor temperature, and core power distribution) is an iterative process involving conceptualization, modeling, model and setpoint evaluations, and performance analyses. The AP600 transient performance requirements are largely included in other advanced Westinghouse NSSS designs, hence no feasibility or major design issues are anticipated.

The AP600 control systems will proceed through two levels of design review before documentation for certification is completed. The finalized design will contain generic setpoints that have been exposed to a series of calculations that exercise the controllers over the entire power range and over a range of key core parameters (moderator temperature and doppler coefficients), and control rod worths that reflect the expected variations throughout the entire fuel cycle. Documentation of the finalized control system designs will include time history responses of key system parameters (temperatures, pressures, levels and nuclear power) to demonstrate acceptable stability, overshoots, and margins to trip setpoints for the set of operational transients included in the AP600 design basis.

1990 Plan

- Preliminary functional requirements and preliminary functional diagrams for use in scoping, sizing and defining interfaces for the controlled instrumentation systems will be developed.

WBS Element 2.5.3 Reactor Coolant System Design Transients Analysis

Responsibility of Westinghouse

Purpose

The purpose of this activity is to develop the thermal-hydraulic transients that the RCS and its components will experience over the design life of the plant. This information is the basis for equipment design requirements and is used in subsequent design calculations, equipment specifications, and usage factor analyses. A description of the AP600 design transients and the frequency of their occurrence is included in the certification documentation.

Approach

The RCS design transients are generated using normal design and analysis codes. For the major part, they are best estimate analyses with some degree of conservatism. That is, all systems are assumed to function normally, but some operating conditions and plant parameters are selected to exaggerate pressure, temperature, and flow responses. In this way, anticipated variations in actual plant responses are covered. The RCS design transients are developed and refined throughout the plant design process as information on system and controller performance becomes available, or as new operating conditions or events are identified.

For ease of reference the plant design transient conditions are categorized in the following list.

- Normal – routine plant maneuvers like unit startup and shutdown, load follow, etc.
- Upset – events of moderate frequency like loss of load, reactor trip, control rod drop, etc.
- Emergency – infrequent events like loss of flow, small loss-of-coolant accident (LOCA), etc.
- Faulted – extremely low probability events like a rod ejection, large steam line break, etc.
- Test – system overpressure overload tests

The RCS is subdivided into primary side, steam generator secondary side, pressurizer, and reactor coolant pump, and the transients are grouped accordingly.

The RCS design transients are time history plots of pressure, temperature and flow for all the events that the plant is expected to experience. In addition, there are specifications of the anticipated number of occurrences for each event. This frequency information is based on Westinghouse plant operating experience or plant design specifications (daily load follow, for example).

1990 Plan

- Specific bases for design transients will be established, including specification of events and tests and their frequencies to be included in each category of transient.
- The AP600 specific LOFTRAN thermal/hydraulic computer code model will be developed.
- Transient calculations will be initiated in 1990, but will be completed in 1991.

WBS Element 2.5.4 Shielding and Radiation Analysis

Responsibility of Westinghouse and Bechtel

Purpose

The purpose of this element is to develop the necessary engineering data, criteria, and guidelines to meet applicable regulatory radiation limits and maintain occupational radiation exposures "as low as reasonably achievable" (ALARA). Based on this information, plant radiation shielding designs are developed, to protect the public and plant personnel from radiation during all design and accident conditions.

Approach

Radiation source terms that define the radiation environment for all phases of plant operation including full power operation, shutdown conditions, refueling operations and various postulated accidents are calculated. Westinghouse has continuing programs to collect current plant operating radiation data and maintain state-of-the-art analytical methods.

The major sources of radiation within the plant are nitrogen-16 and the various fission and activation products, including those activated corrosion products that deposit on the surface of areas in contact with the reactor coolant.

Our design takes into account the small defects we assume exist in the cladding of some fuel rods that allow fission products to be released from the core during plant operation.

Normal operating sources are based on plant design features and applicable data from operating plants. These sources are employed in environmental analyses and evaluations where operating conditions over the life of the plant are used.

The energy and spatial distribution of neutron and gamma ray flux in and near the reactor is evaluated and used in establishing primary shield and reactor internals design. This information is also used in correlating the radiation induced shift in the reference nil-ductility transition temperature of the reactor vessel steel with the operating history of the reactor to set the heatup and cooldown rates for the reactor vessel.

Post-accident sources for a broad spectrum of accident scenarios are calculated and used in shield designs to protect the public and plant personnel from the radiation released to the containment building or to the plant environs.

The plant radiation shielding can be categorized into five groups: the primary shield that surrounds the

reactor vessel; the secondary shield that encloses the reactor coolant loops; the refueling shielding that includes the refueling canal walls and water cover; the auxiliary shielding that shields the CVCS and other auxiliary system components; and the accident shielding including the shield building portion of the reactor containment system. The radiation sources and shield requirements are established as described above. The shielding requirements are integrated with structural and layout requirements to arrive at the optional configuration for the components of the various shielding groups.

1990 Plan

- Develop preliminary radiation source terms for various plant conditions
- Calculate worst case RV fluence and reactor internals gamma heating
- Preliminary Radiation Analysis Design Manual
- Preliminary ALARA guidelines
- Develop preliminary radiation zoning diagrams
- COmfirm shielding configuration for major structures

WBS 2.5.5 Hazards Analysis

Responsibility of Bechtel and Westinghouse

Purpose

The purpose of this task will be to evaluate the initial plant design against known operability and environmentally induced hazards. The results will be fed back into the design process, such that the final design will meet or exceed protection requirements for structures and systems important to safety.

Approach

Hazards associated with such events as pipe rupture, tornado, fire, heavy load drop, or flood are evaluated to determine potentially unacceptable consequences to structure and systems important to safety. Consideration of these various events will have an important influence on the final configuration of the plant. It is necessary to perform a systematic analysis of each of these various events based upon the initial design configuration of structures, piping and equipment. For each event, the sources of hazard are calculated or defined based on NRC criteria, then effects of these sources are determined. Leak-before-break criteria will be used, where practical, to eliminate the need to consider pipe break effects. The results of each evaluation of the impact on structures and systems important to safety will be fed back into the design process for structural and system designs to ensure that protection requirements are met or exceeded for structures and systems important to safety. The criteria for acceptance of the hazard conditions is the availability of the minimum number of systems and equipment necessary to safely shutdown the plant.

1990 Plan

Design criteria must be established at the start of the design program regarding the methods and approach to be taken with regard to principal hazards including pipe rupture, tornado, fire, load drop and floods. In addition, the strategy for handling the hazard needs to be developed as an input to the plant design process. Task milestones include:

- Develop Design Criteria for Hazards
- Develop Design Guides to Minimize Impact of Hazards

WBS Element 2.5.6 Emergency Operating Procedures

Responsibility of Westinghouse

Purpose

To provide a comprehensive and fully integrated set of emergency guidelines.

Approach

The program for developing AP600 design specific guidelines will utilize the Westinghouse Owner's Group Emergency Response Guideline (ERG) framework which has been approved by the NRC for implementation at existing Westinghouse PWRs. Two complementary and interrelated guidelines subsets, one event-related and one function-related, will be produced. Supporting analyses will be performed concurrently with guideline development. Background documentation will also be developed.

The guidelines will provide prioritized operator guidance for recovering the plant from an emergency transient, while at the same time ensuring that the plant safety state is explicitly monitored and maintained during recovery. The systematic evaluation of event sequences using probabilistic risk assessment techniques will be used to evaluate which guidelines should be developed.

Following development, the emergency guidelines will be validated to provide a realistic test of the guideline framework and written guidelines. The guidelines will be verified to ensure their applicability to the control room design. The program tests both the technical and human factor adequacy of the guidelines.

1990 Plan

- Establish a framework for preparation of the procedures based on modification of the framework used for current plants to incorporate the passive safety approach.
- Specific high level response strategies will be developed for a set of emergency events which will help establish the suitability of the AP600 system configurations for dealing with these events.
- The TREAT analyses for high level action strategies will be completed.

WBS Element 2.6 Testing Programs

Purpose

The AP600 Detailed Design and Design Certification Program includes testing to optimize system and component designs and to provide additional verification or more detailed performance data for new design features. This data, together with that from the already-completed conceptual design test programs, will be sufficient to ensure that timely NRC licensing certification of the AP600 will be achieved.

Approach

The following tests are planned to be completed over the course of the program:

- Reactor Coolant Pump Flow Test - Develop flow, head and efficiency data to accurately predict the performance of the full-scale AP600 reactor coolant pump
- Thermal Hydraulic Reactor Vessel Internals Test - Verify the hydraulic characteristics of the AP600 vessel and internals (e.g., flow distribution and pressure losses) with a scale model test (approximately one seventh scale).
- In-Core Instrumentation System Tests - Verify that the proposed system is not susceptible to EM interference from the nearby Control Rod Drive Mechanisms. Demonstrate that the system will not be subject to flow-induced vibration which could lead to fretting wear.
- DNB Test - Perform testing to extend the lower flow limit of the NRC-approved DNB correlation to cover the low core coolant velocities of the AP600
- PCCS Water Distribution Test - Demonstrate on a large scale the capability to distribute water on the steel containment dome outer surface as part of the PCCS function.
- PCCS Heat Transfer Test - Examine on a large scale the combined natural convection condensation on the interior of the containment

with the exterior film evaporation behavior and air cooling heat removal. A one-eighth scale steel containment structure with exterior water film and air cooling will be constructed for this test.

- PCCS Wind Tunnel Test - A plastic scale model of the entire AP600 plant will be constructed, and tests will be performed on the model to demonstrate that adjacent buildings will not adversely affect the passive containment natural draft air cooling.
- Long Term Cooling Test - Demonstrate the natural convection post-accident cooling mode for the AP600 on a small-scale glass and plastic model. Include the operation of the gravity makeup path from the IRWST and long-term core cooling via natural circulation.
- Automatic Depressurization System Hydraulic Test - Simulate operation of the ADS function of the PSIS on a pressurized steam/water test loop. Confirm the operability of the ADS valves and spargers and determine the dynamic effects on the IRWST structures.
- Component Tests - Verification testing of individual components to confirm their operability or to verify that component materials and fabrication methods meet ASME requirements. Six tests are included in this activity.
  - Core Makeup Tank Performance Test
  - SG to Pump Material Welding Test
  - RC Piping Bending Test
  - Composite Concrete/Steel Structural Tests
  - PSIS Check Valve Tests
  - I&C Class 1E Cabinet Test

- Baseline Tests - Additional Baseline testing will be performed in existing facilities from the Conceptual Design Program to establish a larger database for design optimization during the Detail Design Program. Four tests are included in this activity:

  - RCP/SG Airflow Test
  - High Inertia Journal Bearing Test
  - PRHR Heat Exchanger Performance Test
  - Integral Containment Cooling Test

A Test Specification will be prepared initially for each test to provide a basis for the test facility design and the test procedures. Where applicable, detailed computer modeling and analyses are included in the program both to predict test results and to enable test results to be extrapolated to predict prototypic plant behavior. Finally, the test results will be documented in reports which will include the test requirements, test plan, test design description, test data, and test data analysis.

1990 Plan

The emphasis will be on completing design optimization testing. Also, detailed specifications for the larger scale safety system tests will be developed. On the basis of these specifications, the test facilities will be designed and long lead time components will be ordered so that these tests can be completed in 1991. Overall, the testing work plan supports the systems design and safety analyses activities. Major milestones are as follows:

- Complete In-Core Instrumentation EM Interference Test and Issue Report
- Prepare DNB Test Specification
- Complete PCCS Water Distribution Test and Issue Report
- Complete PCCS Heat Transfer Test Vessel Procurement Specification
- Complete PCCS Wind Tunnel Test and Issue Report
- Prepare ADS Test Specification
- Prepare CMT Performance Test Specification
- Prepare PSIS Check Valves Test Specification
- Complete RCP/SG Airflow Test and Issue Report
- Issue RCP Journal Bearing Phase 1 Test Report
- Issue PRHR Heat Exchanger Phase 1 Test and Issue Report
- Complete PRHR Heat Exchanger Phase 2 Test and Issue Report

- Integral Containment Cooling Test Phase 2 Test Specification

WBS Element 2.6.1 Reactor Coolant Pump Flow Test

Responsibility of Westinghouse

Purpose

Because of the direct effect of coolant flow on reactor performance and safety margins, it is essential that the reactor coolant pump hydraulic performance (head, flow, efficiency) be verified before AP600 design certification is granted. Established Westinghouse practice on new pump models is to perform a large scale low pressure, low temperature water flow test on a model (typically one-half scale) of the complete pump hydraulics (impeller, diffuser, casing). This test accurately predicts the head, flow, and hydraulic efficiency of the full scale pump.

Approach

The pump flow test will be performed by the Westinghouse Electro-Mechanical Division (EMD). The pump hydraulic elements are scaled dimensionally at 58 percent of the full size reference pump. The test will make use of the impeller and diffuser previously designed and fabricated for the pump/channel head airflow test (See WBS 2.6.11.1). An existing drive motor and instrumented water loop at EMD will be employed in this test.

1990 Plan

- Design and procurement of long-lead test parts will begin such that actual testing can be performed in 1991.
- A preliminary RCP Flow Test Spec will be prepared

WBS Element 2.6.2 Thermal Hydraulic Reactor Vessel Internals Test

Responsibility of Westinghouse

Purpose

This test will be approximately a one-seventh scale model of the reactor vessel and internals including vessel inlet and outlet coolant nozzles. The purpose of the test is to verify the hydraulic characteristics of the AP600 vessel and internals (e.g., flow distribution and pressure losses) including the AP600-specific design features which differ from previous standard designs.

Approach

An evaluation will be performed to establish the size, hydraulic characteristics and flow and instrumentation requirements necessary to perform a scale model test. Test requirements will be prepared and a test plan written. Drawings will be prepared for the model and internals (fuel assembly hydraulic resistance will be simulated by orifices). The test uses a rather large hydraulics loop; the facility design will be established to accommodate the AP600 model. Testing will be performed over a range of flow conditions expected in the actual plant, including a possible mismatch in the flow rates in the four inlet nozzles. During the test, it may be necessary to include several minor modifications to the internals in order to achieve the proper flow distributions. For example, it may be necessary to change the pattern and/or size of the holes in the bottom core support plate to optimize the flow distribution within the core from a thermal performance viewpoint.

1990 Plan

Work on this test is scheduled to start after calendar year 1990.

WBS Element 2.6.3 Incore Instrumentation System Tests

Responsibility of Westinghouse

Purpose

Systems similar to the AP600 top mounted fixed incore detector (FID) instrumentation have been demonstrated in operating plants, but have not been implemented in the planned AP600 specific geometry/c nfiguration. A test is required to demonsrtrate that the system will not be susceptible to electro-magnetic interference from the nearby Control Rod Drive Mechanisms. It is also necessary to show that the design will not be subject to flow induced vibration which could lead to fretting wear and failure of the FID pressure boundary thimble.

Approach

The EM Interference test will be performed by mocking up to the instrument cables, bringing them into close proximity with an operating control rod drive mechanism, and measuring the resulting noise induced on simulated flux signals.

For vibration testing, a full scale FID pressure boundary thimble, external guard tube housing, internal guide tube and support column, spring loaded fuel nozzle insert guide, and the top fuel nozzle and fuel instrument thimble will be fabricated of actual specified materials. These will be housed in a low pressure/low temperature water pressure vessel and jacket which mocks-up the fuel & internals flow geometry. Pump flow at rated mass velocity and pump overspeed (~1.15%) conditions will be provided to stimulate the worst case flow induced vibration of the reactor for several hundred hours. Disassembly and inspection for wear will follow.

1990 Plan

- Complete EM Interference test report.
- Work on the flow induced vibration test is scheduled to start after calendar year 1990.

WBS Element 2.6.4 Departure from Nucleate Boiling (DNB) Test

Responsibility of Westinghouse

Purpose

The larger than normal reactor core diameter associated with the low power density design of the AP600 results in core coolant velocities which are generally lower than in a conventional PWR. Where a conventional plant will have nominal core coolant velocities in the range of 14 to 16 feet per second (fps), the nominal coolant velocity in the AP600 core is only 10.7 fps. Consequently, under certain transient conditions the core flow rate drops below 0.9×10^6 lb/hr-ft^2 (approximately 5.5 fps) which is the current limit of the NRC-approved DNB correlation. The purpose of this test is to extend the correlation limit to a lower value by performing tests under low flow conditions.

Approach

While low flow DNB tests have been performed successfully on other fuel assembly geometries, data accumulated over several years of testing on the current Westinghouse fuel designs have concentrated on the higher flow range associated with operating conditions of the conventional, higher power density cores. To perform a series of low flow tests, one or two test bundles will need to be constructed. The design of the test bundle will be identical to those used in the past and will consist of a small array (generally a 5 by 5 array) of rods, which are electrically heated and well instrumented with thermocouples. The components for the test bundles will be shipped to the test site and assembled just prior to testing.

Sufficient data will be taken to provide a basis for reducing the lower limit on mass velocity by 60 to 70 percent from the current value of 0.9×10^6 lb/hr-ft^2 (i.e., to the 3 to 4 fps range). Since the AP600 has a large DNB margin, this test is not expected to impact the core or fuel assembly design in any way, but it will be necessary to perform the test in order to

change the correlation limits to obtain design certification.

1990 Plan

- Fuel thermal/hydraulic analyses will be reviewed to finalize the range of flows required to be tested.
- A test specification will be prepared to provide the basis for manufacturing the test rod bundle and scheduling the test facility. Actual testing is to be performed in 1991.

WBS Element 2.6.5 Passive Containment Cooling System Water Distribution Test

Responsibility of Westinghouse

Purpose

The purpose of this test is to perform a large-scale demonstration of the capability to distribute water on the steel containment dome outer surface as part of the PCCS function.

Approach

The test may be performed on an existing steel tank 40 feet in diameter with a top dome shape that approximates the AP600 containment dome. The tank top will be surveyed to identify variations in the surface topography, and the AP600 water supply/distribution arrangement will be duplicated. An alternative under consideration is to perform the test using a mock-up of a slice of the containment dome. The test will then be conducted to demonstrate and measure the water spreading from the top center of the tank to the outer edges. Modifications to the water distribution arrangement will be made as necessary based on initial test results.

A final test will be conducted with the surface coated with prototypic AP600 containment coating. This test will include detailed measurements of water film velocities and film thickness variation as a function of flow rate and radial distance.

1990 Plan

This test will be completed in order to establish the basis for the water distribution management design for the AP600.

- PCCS Water Distribution Test Specification
- PCCS Water Distribution Test Report

WBS Element 2.6.6 Passive Containment Cooling System Heat Transfer Test

Responsibility of Westinghouse

Purpose

The purpose of this experiment is to examine, on a large scale, the combined natural convection condensation on the interior of the containment with the exterior film evaporation behavior and air cooling heat removal. This larger scale radial experiment will accurately model both the containment dome heat transfer natural circulation inside the containment, and will complement the existing integral containment experiment which simulated the side wall condensation and falling film heat transfer.

Approach

A one-eighth diameter scale steel containment structure with exterior water film and air cooling will be constructed. Detailed instrumentation on the containment wall will measure the condensation heat flux distribution, the resulting heat transfer coefficients, the air/steam mass ratios, and the resulting liquid film evaporation. Calculations of the current integral containment experiment and this larger containment test will be modeled using the detailed analysis model to verify the code and to show the scalability of the results.

1990 Plan

The test specification will be completed to the level of detail required to procure the test vessel and complete design of the test facility.

- PCCS Heat Transfer Test Specification (Intermediate)
- Test Vessel Procurement Specification
- Test Facility Design

WBS Element 2.6.7 Passive Containment Cooling System Wind Tunnel Test

Responsibility of Westinghouse

Purpose

The purpose of this experiment is to demonstrate that adjacent buildings will not adversely affect natural circulation air cooling through the Shield Building. The effects of high wind on the induced natural convection draft flow in the containment annulus and the resulting baffle static pressure distribution will also be examined.

Approach

A scaled model of the entire AP600 plant will be constructed from plastic and instrumented with static dynamic pressure taps. The model will be placed in a large scale wind tunnel and tested over a range of air speeds to simulate different adverse wind conditions.

1990 Plan

This test will be completed in order to finalize the air inlet and outlet designs for the natural draft PCCS air cooling flow and to support the mechanical design of the air cooling baffle.

- PCCS Wind Tunnel Test Specification
- PCCS Wind Tunnel Test Report

WBS Element 2.6.8 Long Term Cooling Test

Responsibility of Westinghouse

Purpose

The purpose of this experiment is to simulate the natural convection post-accident long-term cooling mode for the AP600. This experiment will demonstrate the operation of the long-term gravity makeup path from the in-containment refueling water storage tank (IRWST) and long-term core cooling via the natural circulation flow path from the flooded containment.

Approach

A small scaled experiment made of glass and plastic will be used to simulate the reactor vessel, IRWST, the core makeup tank, the pressurizer and the lower containment structure. The connecting piping will be simulated. The hot legs and cold legs will only be simulated up to the CMT and pressurizer connections. There will be no simulation of the steam generators or pumps. Freon 113 will be the working fluid and the core will be simulated with electric heater rods scaled to match core decay heat.

1990 Plan

This test will be completed to demonstrate the long-term, post-accident cooling path in the AP600 design.

- Long Term Cooling Test Specification
- Long Term Cooling Test Report

WBS Element 2.6.9 Automatic Depressurization System Hydraulic Test

Responsibility of Westinghouse

Purpose

The purpose of this test is to simulate operation of the ADS function of the PSIS in order to confirm the operability of the ADS valves and spargers, and to determine the dynamic effects on the IRWST structures.

Approach

A pressurized heated water/steam source will be used to simulate steam/water flow and temperature relieved from the AP600 reactor coolant system during various stages of the ADS blowdown. The blowdown fluids will be piped to a protypically sized sparger located in a simulated section of the IRWST. The piping will be designed to accommodate at least one of each ADS valve type. Instrumentation to measure water and steam flow rate, equipment dynamic loads, IRWST dynamic loads, and sparger/IRWST steam quenching will be provided.

1990 Plan

The test specification and procedures will be finalized. The test valves and sparger will be procured, and the test facility will be assembled so that testing can begin before the end of the year.

- Detailed Valve Procurement Specification
- Detailed Sparger Procurement Specification
- Complete Test Loop Design
- Final ADS Test Specification
- Complete Test Loop Assembly
- Detailed Test Procedure

WBS Element 2.6.10 Component Tests

Responsibility of Westinghouse

This task is composed of verification testing of individual components to confirm their operability or to verify that component material and fabrication methods meet ASME requirements. The individual tests are described in the following paragraphs.

WBS Element 2.6.10.1 Core Makeup Tank Performance

Purpose

The purpose of this experiment is to verify the gravity drain behavior of the CMT and the tank level indication which acts as a control for the ADS. The CMT drains by gravity head into the RCS while steam is vented from both the cold leg and pressurizer with different size steam lines. The volume of water drained is replaced by steam which condenses and can impact the tank draining performance. The objective is to verify that the tank will drain as calculated in the safety analysis models.

Approach

A one-sixth scale CMT will be constructed and supplied with high pressure steam. The CMT and steam/water lines will be instrumented to obtain the condensation rates within the tank such that the computer model for the tank can be verified. The CMT water delivery and the performance of the level measurements will be examined over a range of conditions to verify the level measurement performance for ADS actuation.

1990 Plan

The test specifications and procedures will be finalized. The test tank will be procured, and the test facility will be assembled so that testing can begin before the end of the year.

- Test Tank Procurement Specification
- Complete Test Loop Design
- Final Test Specification
- Complete Test Loop Assembly
- Detailed Test Procedure

WBS Element 2.6.10.2 Steam Generator to Pump Material Welding Test

Purpose

The preferred pump casing material (because of its high allowable stress and excellent corrosion resistance) is a 13 chrome - 4 nickel alloy (SA487) which has not previously been welded in nuclear applications to the low alloy carbon steel (SA508) material being used for the steam generator channel head or the 316SS discharge pipe material. A transition weld test may be needed to verify the welding procedures, weld adequacy, and the code compliance of these weld joints.

Approach

Weld test samples of representative channel head nozzle, pipe and pump materials will be procured. These samples will duplicate manufacturing process (forging and casting), heat treatment and thicknesses specified for the AP600 components. Trial welding procedures based on other transition welding experience will be developed. The as-delivered mechanical properties of the samples will be determined in a certified test laboratory, the samples will be welded using the range of procedures specified, and then the welded test samples will be inspected and tested for soundness (ultrasonic test (UT)), dimensional change, and post weld mechanical properties.

1990 Plan

Work on this test is scheduled to start after calendar year 1990. This test may be deleted based on a review of existing industrial experience in welding the selected materials.

WBS Element 2.6.10.3 Reactor Coolant Piping Bending Test

Purpose

The large diameter, heavy wall main coolant piping of the AP600 RCS employs long radius pipe bends which have not previously been used for this type of application. The test is necessary to demonstrate that the bending process and the resulting product have adequate mechanical and dimensional properties and fully comply with ASME code requirements.

Approach

Sufficient 22-inch ID cold leg piping and 31-inch ID hot leg piping will be procured to produce three test samples of each size. Materials properties of these as-delivered pipes will be determined by laboratory testing. The pipe will then be shipped to the bending shop where the pipe samples will be hot induction bent to the specified (3-D and 5-D) hot and cold radii. Materials testing samples will be taken and mechanical properties determined by a certified testing laboratory. The pipe bend samples will be inspected for dimensional changes (wall thinning and thickening) and accuracy of bend radius.

1990 Plan

- Detailed test specification will be completed
- The test articles (pipe sections) will be procured for delivery in 1991.

WBS Element 2.6.10.4 Composite Concrete/Steel Structural Tests

Purpose

The purpose of these tests is to confirm the behavior of the concrete filled steel plate structures used in the modular construction of the containment interior structures and to develop and justify the criteria established for their design.

Approach

Simple beam and slab models will be constructed to represent typical design configurations used in the interior structure steel models. The prototype structures are typically 2 to 4 feet thick with one-half inch steel plates on each side. The test models will be approximately one-quarter scale so that the exterior plates are one-eighth inch thick. The test models will be designed in parallel with design of the AP600 structures such that they investigate the critical design assumptions. Typical beams will be tested under axial and transverse loading. Typical slabs will be tested under in-plane and out-of-plane loading. Testing will include monotonic and cyclic loads representing seismic conditions.

1990 Plan

Work on this test is scheduled to start after calendar year 1990.

WBS Element 2.6.10.5 Passive Safety Injection System Valve Tests

Purpose

A test will be conducted to demonstrate the capability of the PSIS check valves to open under low pressure differential conditions which exist during gravity drain injection.

Approach

The check valve low pressure differential opening tests will consist of duplicating normal pressure and temperature conditions on both the upstream and downstream sides of each of the several PSIS check valves. These temperature and pressure conditions then will be changed to model the response to various design basis events, approximating the expected gravity or natural circulation flow conditions.

1990 Plan

The test specification and test procedures will be finalized. The test valves will be procured, and the test facility will be assembled so that testing can begin before the end of the year.

- Detailed Valve Procurement Spec
- Complete Test Loop Design
- Final Check Valve Test Spec
- Complete Test Loop Assembly
- Detailed Test Procedure (incorporating lessons from shakedown testing)

WBS Element 2.6.10.6 I&C Class 1E Cabinet Temperature Test

Purpose

This test will demonstrate the capability of the I&C components required for safety system actuation and reactor monitoring to operate following a station blackout (Code of Federal Regulations, Section 50.2) for an extended period of time (at least 3 days).

Approach

Cabinets containing typical I&C electronic components will operate at the range of temperatures expected following a station blackout. Temperatures throughout the cabinet will be monitored to ensure that present component qualification temperature limits are not exceeded. Modifications to card orientations, card density, and cabinet air inlet/outlets will be made if required.

1990 Plan

Work on this test is scheduled to start after calendar year 1990.

WBS Element 2.6.11 Baseline Tests

Responsibility of Westinghouse

This task provides for additional baseline testing in five existing facilities from the Conceptual Design Program. These baseline tests will establish a larger data base for design optimization during the detailed design program. These baseline tests are described in the following paragraphs.

WBS Element 2.6.11.1 RCP/SG Airflow Test

Purpose

The novel configuration of the steam generator channel head and pump configuration warrants performance verification testing along with design analysis. The airflow test will identify effects on the pump performance due to non-uniform channel head flow distribution, pressure losses of the channel head nozzle dams and pump suction nozzle, and will identify possible vortices in the channel head caused by the pump impeller.

Approach

The air test facility at EMD will be an approximate one-half scale mockup of the outlet half of the channel head, the two pump suction nozzles, and two pump impellers and diffusers. The channel head tube sheet will be constructed from clear plastic to allow smoke flow stream patterns to be seen. The mockup will include pressure tap, velocity tap, and motor power measurement instruments. Air will be drawn through the mockup by fans and the pump impellers. The test will be performed in stages, to segregate and identify each component's contribution to pump performance.

1990 Plan

This test began under the Conceptual Design Program will be completed in 1990.

- RCP Airflow Test Report

WBS Element 2.6.11.2 High Inertia Journal Bearing Test

Purpose

The high inertia journal bearing, which is being tested at the Westinghouse Research and Development Center, is twice as large as any previously constructed water-lubricated bearing. Calculations of bearing friction and rotor drag losses could not be reliably extrapolated to this size of bearing. A test is necessary to accurately determine drag losses and verify the performance of the large radial pivoted bearing. The testing scope in the Conceptual Design Program was limited to obtaining data on the overall performance of the high inertia bearing. A number of additional tests will be performed in the Detailed Design Program to develop a detailed quantitative knowledge of the factors influencing bearing design and performance.

Approach

A full-scale high inertia journal bearing has been constructed with journals, radial bearing and thrust bearing. This assembly is mounted on a shaft and placed in a dynamometer test stand. Low-pressure water is circulated around the bearing and a motor spins the bearing to pump operation speeds. Friction and drag losses are obtained from the dynamometer. Hydraulic cylinders load the radial and thrust pads to verify bearing performance. Data can be obtained over a large set of operating conditions and speeds.

The following Detail Design Program tests are planned for in the high inertia bearing test rig to develop needed verification data for design certification and optimization:

- Measure the axial rotor gap effect on parasitic drag loss
- Perform a start/stop life test (approximately 1000 cycles) to ascertain bearing wear and test journal dimensional stability

- Measure the effects of bearing preload on bearing performances
- Measure the motion of an unloaded pivoted bearing pad to verify satisfactory stability and wear behaviors
- Measure the radial clearance effects of increased radius of curvature bearing pads on performances
- Perform post-test destructive examination of the depleted uranium, stainless steel enclosed test journal to verify its design suitability

1990 Plan

- Issue test report from Conceptual Design Program
- Prepare detail test spec for Detailed Design Program Test
- Begin Detail Design Test Program

WBS Element 2.6.11.3 Passive Residual Heat Removal Heat Exchanger Performance Test

Purpose

The PRHR HX test was designed to characterize the performance of the heat exchanger. The purpose of the test was to determine the heat transfer characteristics of the PRHR and the mixing characteristics in the IRWST. These key issues are instrumental in determining the final heat exchanger size and configuration.

The test facility consists of three full-length heat exchanger tubes placed in a vertical cylindrical tank filled with water to simulate the AP600 IRWST. Under the AP600 Conceptual Design Program, the test consists of running water at prototypic natural circulation and forced flow rates through the heat exchanger tubes at prototypic system pressure and temperatures. The following is a description of further tests proposed to be conducted on the existing PRHR test facility during Phase II.

Tube Pitch Test

The purpose of this test will be to test various tube flow rates at prototypic conditions. An alternate tube pitches will be examined to determine the effect on heat exchanger design. Various baffle arrangements that improve heat transfer will also be investigated.

Steam Flow Test

The purpose of this test will be to determine the heat transfer capability of the PRHR HX when steam is circulated through the heat tubes.

Non-condensable Test

The purpose of this test is to demonstrate that the presence on non-condensable gas in the reactor coolant system will not block natural circulation water flow or seriously impede heat removal.

Approach

The planned extensions of the PRHR HX test will make use of the existing test facility with a minimum amount of hardware changes as needed. The tests will be performed at near prototypic conditions

1990 Plan

A test report documenting the initial PRHR tests during the Conceptual Design Program will be issued. A detailed test specification for testing to be conducted for Phase II, incorporating lessons learned from the initial testing will then be prepared; the tests will be performed; and a final report covering all PRHR tests will be prepared.

- PRHR Heat Exchanger Test Report (Conceptual Design Program)
- PRHR Phase II Test Specification
- PRHR Heat Exchanger Test Final Report

WBS Element 2.6.11.4 Integral Containment Cooling Tests

Purpose

The purpose of these tests is to demonstrate the operation of the PCCS over an increased range of operating conditions including postulated severe accident conditions; to evaluate the impact of low environmental temperatures on the containment and air baffle structures; to establish containment heating requirements during long term shutdowns; and to demonstrate the local impact of prototypic air baffle supports on the cooling air flow and water film behavior. These tests in conjunction with completed conceptual design phase testing and the large scale containment test (WBS Elements 2.6.5, 2.6.6, and 2.6.7) will fully characterize the PCCS design and performance.

Approach

The current PCCS integral containment cooling test facility has a working design pressure of 100 psig; it will be used to simulate severe accident pressure/temperature conditions. Non-condensable gas concentrations can also be simulated here.

The current test facility will be modified to enable operation in cold weather. Additional heat removal data will be obtained to evaluate the need for coatings to avoid ice formation on the air baffle.

1990 Plan

A detailed test specification will be prepared incorporating the lessons learned from tests conducted during the Conceptual Design Program. The test matrix to be incorporated in this specification will also factor in requirements for supplementing the tests that will be performed in the larger facility (WBS 2.6.6) so that the test results obtained at the larger facility will be better understood. Based on this specification, additional testing will be performed at the existing Integral Test Facility in 1990 and 1991.

- Integral Containment Cooling Test Specification

2.6.11.5 Hydroball Prototype Test

This test was performed during the Conceptual Design Program. The decision has since been made to use an alternative incore measurement system. A report on the tests performed during the Conceptual Design Program was issued in February 1990.

3.5 DESIGN CERTIFICATION

Design certification activities include four level 2 elements – safety analysis and evaluations, safety documentation, defense of application for final design approval, design certification rulemaking support.

WBS Element 3.1 Perform Safety Analyses and Evaluations

Purpose

To provide analysis of the response of the plant and an assessment of consequences for postulated disturbances in process variables and malfunctions or failures of equipment. Also to provide a PRA to expose severe accident vulnerabilities and to add assurance of no undue risk to public health and safety.

Approach

The AP600 design basis accident assessment will be performed in accordance with the guidelines established in ANS 51.1 (ANSI N18.2) and reflected in Chapter 15 and Chapter 6 of the Standard Review Plan, NUREG-0800. Sensitivity studies for selected events are performed early in the design phase to enable effective feedback to the design activities.

The AP600 PRA will be completed consistent with the methodology established in NRC guidance for individual plant evaluations. It will provide a detailed assessment including plant, containment, and site analyses, and will consider internal and external events. Early application of probabilistic analysis techniques is also used in the design process as an aid in the selection of design alternatives and to ensure that the overall level of safety of the completed design will meet design objectives.

1990 Plan

- Safety analysis and evaluation will be initiated as required to support the design effort and to demonstrate licensability of the design.

WBS Element 3.1.1 Design Basis Accident Analysis

Responsibility of Westinghouse

Purpose

To perform the design basis accident analyses required to support the design and development of the AP600 plant configuration and to support plant safety evaluation and design certification approval by the NRC.

Approach

Design basis accident analysis including LOCA, non-LOCA, and containment analysis will be performed.

The hypothetical large break LOCA event is the historic design basis accident for commercial nuclear reactors. Calculated emergency core cooling system performance must meet the Acceptance Criteria of 10 CFR Part 50.46 for postulated break sizes up to, and including, the double-ended rupture of a primary coolant pipe. Westinghouse will utilize advanced large break LOCA technology to demonstrate the compliance of the AP600 plant and its unique features with the 10 CFR Part 50.46 limits. Given its low power density core, the AP600 plant is anticipated to possess significant margin when compared to the acceptance criteria limits.

Analyses will be performed to determine the effectiveness of the AP600 plant passive safeguards systems for a spectrum of small break LOCA events. Postulated small break LOCA events will exercise both the PSIS and ADS capabilities of the AP600 design. The emergency core cooling system performance during small break LOCA must comply

with the acceptance criteria of 10 CFR Part 50 46. The NOTRUMP computer code will be employed to calculate the transient behavior of the AP600. NOTRUMP is a state-of-the-art code developed by Westinghouse which addresses all of the post Three Mile Island event concerns expressed by the NRC.

The initial small break LOCA effort will be undertaken to identify an optimal design of the AP600 plant passive safeguards systems. After necessary testing and NOTRUMP code development pertinent to the AP600 plant design has been completed, sensitivity cases will be executed varying the passive safety system design parameters for a spectrum of small break LOCAs. The small break LOCA predictions, together with the predicted system behavior for other accidents, will collectively define a safety system design suitable for mitigating all postulated accidents. Once the AP600 plant design is finalized, the licensing basis small break LOCA analysis will be performed to demonstrate compliance with the acceptance criteria.

The non-LOCA accident analysis will use methodology based on past licensed methodology developed for conventional PWR. The conventional PWR models, assumptions and data will be reviewed to ascertain that they are applicable to the AP600 plant configuration. Where appropriate, modifications will be made to the models or methodology.

The AP600 containment utilizes natural convection/condensation heat transfer to the steel containment pressure vessel and to structural heat sinks inside containment to remove decay heat following a design basis accident. Heat is removed from the outside of the containment vessel by natural circulation draft convective heat transfer supplemented by water film evaporation.

COMPACT, a general-purpose multinode containment code, will be used to analyze containment pressure/temperature response to design basis accidents because the code has the physical models to predict the complex passive containment heat removal processes.

To ensure that post-accident containment pressure and temperature will be within acceptable limits, two postulated accidents will be analyzed using COMPACT. A large steam line break will be analyzed to ensure that the short term peak pressure and temperature are within the design limits. A large break LOCA will be analyzed to ensure that containment pressure and temperature can be adequately reduced and maintained over the long term.

Sensitivity studies will be performed to investigate the effects of key physical parameters on containment pressure/temperature transients. These parameters include steel shell heat transfer surface areas and heat transfer coefficient, and external shell flow distribution. Such investigations are necessary to ensure that adequate thermal margin is provided for the current passive containment design to account for any modeling uncertainty and heat transfer degradation during the containment design lifetime.

In addition, a severe accident hydrogen control analysis will be performed. This will include analyses to assess zircaloy-water reactions, local hydrogen detonation, and equipment survivability. COMPACT analysis will be performed to study hydrogen mixing, distribution, and combustion in containment using the mass/energy input from MAAP analysis. The MAAP code (Modular Accident Analysis Program) is an integrated primary system and containment thermal hydraulic and fission product transport and deposition code. The TAP-A code (heat conduction code) will be used to assess equipment survivability.

1990 Plan

- Non-LOCA safety analyses will be initiated to support design activities

- Modifications will be made to the NOTRUMP code to account for the passive design features
- A meeting to review the supporting AP600 test program plan will be held with the NRC.

WBS Element 3.1.2 Probabilistic Risk Assessment

Responsibility of Westinghouse

Purpose

A level 1, 2, and 3 PRA, including internal and external events, will be performed to:

- Demonstrate that the plant design meets all PRA based regulatory safety requirements.
- Based on risk, identify design vulnerabilities, evaluate alternate design features and operational strategies, and modify the design to reduce risk.

Approach

A PRA consists of an analysis of plant design, operation, and maintenance that focuses on the accident sequences that could lead to severe fuel damage, containment challenge, and offsite consequences. This analysis addresses the basic causes and frequencies of these accident sequences and how the plant systems and containment respond. The assessment will include plant (level 1), containment (level 2), and site (level 3) evaluations. The plant evaluation will identify dominant accident sequences and quantify core damage frequency, the containment evaluation will identify frequency of release and the magnitude of releases to the environment, and the site evaluation will specify offsite consequences. Internal and external events will be considered.

The PRA process will be integrated into the design process where necessary to ensure the design effort meets the targeted goals and resolves the identified vulnerabilities. The method used to accomplish this is an iterative process which requires developing a PRA model of the reactor base design, verifying that the PRA model is correct, identifying design weaknesses (through the quantification of core damage frequency, frequency of releases, and the consequences), and evaluating alternate system designs and/or operational strategies to "optimize" plant safety. Several feedback loops are included within the evaluation process. The first is used to modify the PRA model if it is determined to be inadequate. The next two loops are used to evaluate alternate designs and operational strategies. Close interaction between the plant designers and PRA analysts will be maintained to ensure that severe accident vulnerabilities are considered as part of the design process.

The plant (level 1) analysis will determine the plant response to accident conditions. Initiating events will be developed and their corresponding frequencies determined based on plant specific design. Event trees will be used to model plant response to the postulated accidents (initiating events) and success criteria will be developed. Fault trees will be used to assess system reliability for the determined success criteria. A support state model will be used to address the major support systems.

The assessment will also consider system testing and maintenance requirements, human interaction modeling, and interdependencies between systems. Testing and maintenance will be modeled directly in the system fault trees. The human interaction modeling will address errors of omission and errors of commission. Interdependencies will be addressed in the support state model and through common cause modeling. Accident sequence quantification will identify the dominant accident sequences and key recovery actions, plant damage states, and core damage frequency.

The containment performance (level 2) analysis will calculate source terms and perform a containment response analysis for sequences which dominate risk. The containment analysis will be compatible and

integrated with the plant assessment. The major processes influencing severe accident progression, including phenomenological issues, recovery from severe accident states, and fission product transport behavior within the primary system and containment will be addressed. In addition, the status of plant systems and their effect on phenomenological issues will be addressed. A containment event tree will be developed to address sequences leading to releases. The MAAP code will be used in this assessment. MAAP is an integrated primary system and containment thermal hydraulic and fission product transport and deposition code. The containment evaluation will provide release frequencies and radionuclide release magnitude by accident sequence groups.

The site consequence (level 3) analysis will be based on the results of the plant and containment analyses. Representative site models will be developed which include meteorological and offsite population modeling. Radionuclide releases from containment and possible emergency response actions will also be modeled. Offsite consequences will be calculated based on the characteristic site model, radionuclide releases, and offsite emergency response actions and will use the MACCS code (MELCOR Accident Consequence Code System).

External event evaluation will include assessments of internal fires, internal flooding, seismic events, and other external events. The plant response to each external event will be assessed including evaluations leading to core damage frequency, releases, and consequences as necessary. The seismic assessment will be based on generic fragilities with subsequent detailed assessment of the critical components. The site location for the external event assessment will be chosen consistent with the EPRI generic site criteria.

1990 Plan

- The PRA levels 1 and 2 analyses will be initiated.

WBS Element 3.1.3 Licensing Basis Commitment Management

Responsibility of Westinghouse

Purpose

To establish and maintain a baseline of plant licensing requirements and safety commitments throughout the detailed design phase and to establish a plan for implementation and verification of design certification commitments as required for receipt of a plant operating license.

Approach

A baseline of regulatory criteria applicable to the AP600 design will be established at the onset of the detailed design phase and will be revised as necessary to incorporate changes in regulatory requirements and guidelines throughout the design phase.

The Licensing Review Basis (LRB) document will expand upon the regulatory baseline by identifying the extent of compliance with NRC licensing requirements and guidelines, thereby establishing specific agreements regarding the need for additional rulemaking or the development of alternate NRC review guideline criteria. This document will also establish a specific resolution of applicable Unresolved Safety Issues (USIs) and Generic Safety Issues (GSIs) and implementation plans for NRC safety goal and severe accident policies. The methodology and schedule for NRC safety evaluations and certification rulemaking will also be established in the LRB document.

An active interface will be maintained with the NRC staff throughout the design phase to ensure agreement on acceptable methods for implementing changes to regulatory criteria and policy. Key licensing issue documents will be prepared in a format comparable to the NRC Standard Review

Plan to document the approach being applied to the AP600 design. Following NRC review and acceptance, the licensing baseline will be amended as required.

Receipt of an operating license following construction of the certified design is dependent on the implementation and verification of safety commitments established by the NRC design approval and certification review. A plan to implement these safety commitments will be developed in parallel with SSAR preparation. This plan will include all inspections, tests, analysis, and acceptance criteria required to demonstrate compliance with the safety review basis. The continued Westinghouse participation in the NUMARC Standardization Oversight Working Group/ITAA Task Group will provide assurance that the Westinghouse plan is responsive to the needs of the nuclear industry.

1990 Plan

- The AP600 Design will be compared to:
  - Present licensing criteria
  - Unresolved safety issues
  - Generic safety issues
- A schedule and methodology for the NRC review and safety evaluations will be established
- Participation in the NUMARC standardization oversight working group and ITAAC task group will be maintained
- The AP600 approach to key licensing issues will be prepared

WBS Element 3.2 Safety Documentation

Purpose

The AP600 Detailed Design Approval and Certification Program provides for the development of all documentation required to demonstrate that the plant can be built and operated without undue risk to the health and safety of the public and in compliance with U.S. law.

Approach

Preparation of the AP600 safety documentation begins at the onset of the detailed design phase and continues throughout the AP600 Detailed Design and Design Certification Program.

Early safety documentation efforts focus on the AP600 specific LRB document. NRC review and acceptance of the LRB will provide an up-front agreement regarding the applicability of current regulatory criteria and methods to be followed for the safety review.

Areas where expansion, clarification or additions to current plant licensing criteria are needed to reflect significant departures from previous design practice, will be resolved with NRC during the detailed design phase but prior to submittal of the SSAR. Key Licensing Issue documents, prepared in a format comparable to the NRC Standard Review Plan, provide the basis for establishing suitable acceptance criteria for the safety evaluation of the affected design features.

Early agreement on the LRB and key licensing issues ensures that regulatory acceptance criteria are established for novel plant features in a timely manner. These early agreements support submittal of a single SSAR, replacing the current two step process Preliminary Safety Analysis Report (PSAR) and FSAR.

The AP600 SSAR, supplemented by a PRA, provides the basic design information utilized in the safety review of the application for AP600 design approval. These documents will encompass the total plant design, enabling a complete plant evaluation without the interface difficulties commonly experienced with modular submittals.

In order to ensure that the safety commitments established in the SSAR are adequately implemented during subsequent site-specific design

and plant construction phases, an inspection, test, analysis and acceptance criteria document will be provided for NRC evaluation and approval at the time of SSAR submittal. This document provides the continuity needed to ensure that the operating license can be issued immediately upon completion of plant construction.

1990 Plan

- Efforts will be initiated on the SSAR
- The LRB will be completed and submitted to the NRC

WBS Element 3.2.1 Licensing Review Basis Documentation

Responsibility of Westinghouse and Bechtel

Purpose

To establish agreement between designers and NRC staff regarding the evaluation criteria, procedures and schedules of submittal and review of all documentation required for design approval and certification.

Approach

The LRB will document the review process and safety evaluation criteria that Westinghouse and the NRC staff will use through the FDA issuance.

Top level requirements for plant licensing are provided in 10 CFR Part 50 and 10 CFR Part 52. The LRB will clearly define the extent of compliance with these requirements and establish the process that will be used to establish the continued applicability of these requirements to AP600.

NRC regulatory guidance documents, including the Standard Review Plan, Regulatory Guides, and certain topical reports (NUREGs) establish a well defined base of acceptable criteria from which to evaluate regulatory compliance. However, these guidelines are not substitutes for regulations, and methods and solutions which differ from those set out in NRC regulatory guidance documents are permitted if an acceptable basis for an alternate method of compliance is provided. The AP600 LRB document will include a detailed assessment of the applicability of all existing NRC regulatory guidance documents and will serve to identify those issues for which alternate acceptance criteria is required.

A listing of all safety analyses to be performed will be provided. This list, CDRL SALOOO, will include all design basis accident analyses as well as analyses performed to evaluate accidents more severe than design basis.

A plan for implementation of NRC Severe Accident and Safety Goal policies, including PRA, will be provided.

Unique or novel features that require departures from previous safety review practice will be identified. A method for establishing agreement on the criteria to be used to evaluate these features will be addressed.

A description of the approach that Westinghouse will use to develop the inspections, tests, and analysis required for implementation of the design certification safety commitments will be provided.

The methodology for NRC safety review, with proposed schedule, will be included as will the process that will be used to develop the form and content of the AP600 design certification rulemaking.

1990 Plan

- The LRB document, CDRL DL002, provides for up-front agreement on the technical, administrative, and schedular matters affecting the design and design approval/certification process will be completed and submitted to the NRC.

WBS Element 3.2.2 Key Licensing Issues Review

Responsibility of Westinghouse and Bechtel

Purpose

To provide a process for establishing technically acceptable alternatives to current licensing review criteria in a timely manner.

Approach

A complete assessment of the AP600 passive plant concept to each NRC requirement, guideline, policy, or open issue cannot be ensured until the detailed design is sufficiently developed to support preparation of the SSAR. Further, certain licensing issues for which existing NRC regulatory guidance is not applicable, require the development of alternate criteria to be applied during the staff safety evaluation. The AP600 work plan provides for addressing these key licensing issues during periodic interactions with the NRC staff throughout the design process. Periodic interface meetings are anticipated, during which the licensing issues will be addressed and mutual understandings developed. Key licensing issue documents will be prepared to address each regulatory issue. These documents will be formatted similar to the NRC Standard Review Plan and will be resolved with NRC in a manner comparable to that established for the EPRI ALWR requirements program optimization subjects.

1990 Plan

- Acceptance criteria for NRC safety evaluation of AP600 design will be established and documented for those applicable issues on design features.

WBS Element 3.2.3 Standard Safety Analysis Report

Responsibility of Westinghouse and all subcontractors

Purpose

To prepare a safety analysis document which is sufficiently complete in scope and level of detail to permit the staff to evaluate whether the plant can be built and operated without undue risk to the health and safety of the public in compliance with U.S. law.

Approach

The scope of the SSAR will be sufficient to enable the NRC to reach a final conclusion on safety issues.

The SSAR will be written to demonstrate compliance with the NRC requirements in effect at the time of issue. The SSAR will be written to conform with Regulatory Guide 1.70, Revision 3 "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants" and with the acceptance criteria contained in NUREG-0800 "Standard Review Plan."

The level of detail will be sufficient to ensure complete NRC staff evaluation of all design features important to safety. Recognizing that the plant design is an iterative process, close coordination of design and safety analysis efforts has been established to ensure an efficient development process. The SSAR will be submitted as a complete package to permit efficient NRC evaluation.

The AP600 SSAR will provide all information required for NRC design approval and certification in accordance with 10 CFR Part 52.47.

1990 Plan

- Outlines will be prepared for each SSAR section.

WBS Element 3.2.4 Probabilistic Risk Assessment Documentation

Responsibility of Westinghouse

Purpose

To develop and submit to NRC a final report that documents the results of the PRA.

Approach

Documentation will be prepared for each of the major tasks in the AP600 PRA (Task 3.1.2). This will be consolidated into the final report which will be provided for NRC evaluation. The report will contain, as a minimum, the following sections.

I. Introduction

Background, scope of study, and organization of report will be provided.

II. Compliance

Sources of information and exceptions to the methodology will be identified.

III. Plant Analysis

Plant description, accident initiators, accident analysis, systems analysis, and plant analysis results will be provided.

IV. Containment Analysis

Containment event tree, accident sequence source terms, and containment analysis results will be provided.

V. Site Analysis

The site model and site assessment results will be provided.

VI. Comparison of Results

Comparison to IDCOR results and NUREG-1150 will be discussed.

VII. Evaluation of Results

Identification of insights and analysis conclusions will be provided.

1990 Plan

- Preliminary Level 1 PRA results will be documented

WBS Element 3.2.5 Inspections, Tests, Analysis, and Acceptance Criteria Document

Responsibility of Westinghouse and all subcontractors

Purpose

To prepare and submit to NRC for staff review and safety evaluation a compilation of ITAA criteria suitable for demonstration of compliance with safety commitments established in the FDA and Design Certification during subsequent site specific design and construction activities.

Approach

The ITAA document will be prepared in parallel with the SSAR during the detailed design phase and submitted to NRC in conjunction with the application for final design approval. The basis for preparation of the ITAA document will be provided in the LRB.

Preparation of this document will require a coordinated effort between design, licensing, quality assurance, and project administration activities.

ITAA preparation guidelines will be prepared by the plant licensing activity and provided to all design

activities having input to the SSAR and to quality assurance and projects administration. The design activities will identify suitable inspections, tests, and analysis, with acceptance criteria, in parallel with SSAR preparation. Licensing will compile the input, prepare the ITAA final document and submit the document to the NRC.

The specific format and content of the ITAA document has not been defined in current NRC guidance. It is anticipated that a summary document will be prepared for submittal to NRC providing top level criteria and implementation methodology. Detailed implementation specifications will also be compiled, at a level of detail comparable to existing design, procurement, construction, and installation specifications. These implementation specifications will be available for NRC audit.

It is expected that more specific guidance for ITAA document preparation will be provided during the design phase of the AP600 plant. Westinghouse continued participation in the NUMARC Standardization Oversight Working Group/ITAA Task Group will be maintained to ensure that industry accepted methodology is incorporated into the AP600 effort.

1990 Plan

- Guidelines for ITAAC preparation will be developed and issued.

WBS Element 3.3: Defense of Application for Final Design Approval

Purpose

To secure NRC staff review and safety evaluation of the SSAR, PRA, and ITAA in accordance with the requirements of 10 CFR Part 52.

Approach

The SSAR, the PRA, and ITAA document will be submitted to the NRC for review and safety evaluation under the provisions of 10 CFR Part 52. The submittal will identify that Westinghouse is requesting a review leading to a FDA and that Westinghouse is applying for certification of design in accordance with 10 CFR Part 52, Subpart B

1990 Plan

- No planned activities.

WBS Element 3.3.1 Question and Comment Resolution

Responsibility of Westinghouse and all subcontractors

Purpose

To review and respond to NRC questions regarding the licensing submittals.

Approach

During the review of the FDA application (SSAR, PRA and ITAA), the NRC is expected to ask first round questions that will be necessary to clarify the design and safety features. These questions will be answered using the final design information that will exist. However, it is anticipated that the NRC may require additional calculations or other design and/or safety analysis tasks. During this first round questioning, Westinghouse tentatively plans to hold review meetings with NRC staff members. These meetings will be held both at Westinghouse facilities in Monroeville, PA and Rockville, Md as well as at the NRC office building in White Flint, Md. The answers to the first round questions will be documented as supplementary information on the docket as established in the LRB document.

Following completion of the first round questions, it is anticipated that second (and final) round questions will be asked to both clarify the first round questions, and to follow up on those questions. The answers to these second round questions will be included as supplementary information on the docket as established in the LRB document. The staff will then issue a Draft Safety Evaluation Report (DSER) that will describe the NRC staff conclusions with respect to the safety review.

1990 Plan

- No planned activities.

WBS Element 3.3.2 Safety Evaluation Report Open Items Resolution

Responsibility of Westinghouse and all subcontractors

Purpose

To resolve open items relating to the NRC staff Safety Evaluation Report (SER).

Approach

Following staff review and questioning of the FDA application, a DSER will be issued to document their conclusions.

This DSER will include a list of open items that will require resolution prior to issuance of the SER. The resolution of the open items will be managed by the licensing organization which will secure appropriate input from the involved design and analysis functions. Additional documentation describing the safety features of AP600 as they relate to the open items will be generated. Also, as needed, additional design and/or analysis details will be provided to resolve those open items.

Resolution of the open items will require meetings with the staff, which will be managed in the same manner as previously described for both the first and second round of questions. Following such meetings, answers will be prepared and submitted to NRC as amendments to the licensing documents. The resolutions of these open items will be included as supplementary information on the docket as established in the LRB document.

1990 Plan

- No planned activities.

WBS Element 3.3.3 ACRS Review Support

Responsibility of Westinghouse and all subcontractors

Purpose

To facilitate the ACRS review of the AP600 safety evaluation.

Approach

Following resolution of the DSER open items, the NRC Staff will issue the SER. The ACRS will review the licensing documents and the SER and will hold a number of meetings to ask question regarding features of the plant. The AP600 design and safety analysis will be organized so that a comprehensive, logical presentation of the AP600 will be provided to the ACRS in these meetings. Westinghouse will support these meetings and provide answers during the meeting as required by the ACRS. This support will include representative attendance at the ACRS meetings by appropriate design and safety analysis personnel so that all questions will be answered promptly and effectively. Following these meetings, as required by 10 CFR Part 52, the ACRS will issue a report to the NRC indicating their conclusions with regard to the safety of the plant.

1990 Plan

- No planned activities.

WBS Element 3.4 Design Certification Rulemaking Support

Purpose

To provide the work necessary to support the application for design certification throughout the rulemaking process such that the final rule certifying the AP600 design represents the AP600 in the most commercially acceptable way.

Approach

The design certification rulemaking will be accomplished in accordance with the requirements of 10 CFR Part 52.

The approach will be to facilitate the rulemaking process as much as possible. Technical and legal staff will monitor, to the extent practical, the design certification rulemaking proceedings that may precede the AP600 rulemaking and will establish the form and content of the rulemaking. Extensive interaction with the NRC will follow as part of the AP600 rulemaking process. In addition, because the application must be referred to the ACRS, there may be interaction with the ACRS. The hearings, either, of the legislative or adjudicatory type, will be managed as required. Finally, the AP600 Design Certification Rule will be reviewed to ensure that the program objectives have been met.

1990 Plan

- Input will be provided on the format and content of a design certification rule through the NUMARC standardization oversight committee.

WBS Element 3.4.1 Preparation of Petition for Rulemaking

Responsibility of Westinghouse

Purpose

Provide the work necessary to produce a Petition for Rulemaking that encompasses the design certification of the AP600. This petition for rulemaking will be the basis for the NRC proposed AP600 Design Certification Rule that will be published in the Federal Register.

Approach

As an initial activity, technical and legal personnel will monitor, to the extent practical, the activities that others may be doing with respect to design certification rulemakings for other reactors. This involvement will be primarily to monitor the interaction and to influence these actions, through industry organizations such as NUMARC, so that the precedents set during these proceedings are appropriate for later application to AP600. During preparation of the LRB (see WBS 3.2.1), Westinghouse will initiate discussions with the staff regarding the process to be used to shape the form and content of the AP600 Design Certification Rulemaking.

A detail review of the technical and legal aspects of the Petition for Rulemaking will be performed as part of the preparation of the Petition for Rulemaking. The technical and legal review will consider various matters with respect to the implications of the AP600 Design Certification Rule including the use of the ITAA criteria document. The Petition will consist of four parts; 1) cover letter; 2) statement of considerations; 3) Draft Rule and 4) a section by section analysis of the Draft Rule.

1990 Plan

- No planned activities.

WBS Element 3.4.2 Interaction with NRC and NRC Staff

Responsibility of Westinghouse and Bechtel

Purpose

Work with the NRC and their staff to facilitate the process that will be followed to allow for publication of the Petition for Rulemaking as a Proposed Rule in the Federal Register. Also, to review the published Proposed Rule and provide comments as necessary, and to review the actions of others as they may affect the proposed AP600 Design Certification Rule.

Approach

After issuance of the Petition for Rulemaking to the NRC, described in Task 3.4.1, discussions and meetings with the NRC staff will be required to explain the Petition for Rulemaking and to provide clarification and answers as appropriate. Following these meetings the staff will prepare and publish a Notice of Proposed Rulemaking in the Federal Register. This Federal Register notice will be reviewed to ensure that the Proposed Rule is in conformance with the Petition for Rulemaking Westinghouse provided. Any changes will be identified and if needed, a response letter will be prepared and issued to the NRC providing comments and suggested corrections to the Notice of Proposed Rulemaking.

Comments from other interested parties are also anticipated on the Notice of Proposed Rule. These comments will be either identified directly to Westinghouse by the NRC or will be identified from a review of the Public Document Room. Once these comments are identified, Westinghouse will provide written response to the comments to the NRC.

1990 Plan

- No planned activities.

WBS Element 3.4.3 Hearing Support

Responsibility of Westinghouse and Bechtel

Purpose

The recently issued Standardization Rule, 10 CFR Part 52, provides for public participation in the rulemaking process. The final Standardization Rule 10 CFR Part 52.51 requires that "...the Commission ...specify the procedures to be used for the rulemaking. ...The rulemaking procedures must provide for notice and comment and an opportunity for an informal hearing before an Atomic Safety and Licensing Board (ASLB)...." This task will provide for Westinghouse support of the hearings that will occur. In addition, the ASLB may request Commission authorization for additional procedures or for a formal hearing.

Approach

Westinghouse will participate in discussions with the NRC staff to develop the discrete hearing procedures that will be used to deal with public comments on the Proposed Rule and will participate in any prehearing conferences that will be required. Once the hearing procedure is established, Westinghouse will participate in these hearings, both informal and adjudicatory. It is expected that a period of discovery will proceed the hearings and that some form of public meetings will be held. To ensure that the public has complete access to the public meetings, the NRC may have regional public meetings at various locations around the country. It also is expected that both informal (i.e non-adjudicatory) and formal (i.e. adjudicatory) hearings will be held. Both of these will be supported by Westinghouse.

Following completion of the hearings, a final review of the record will be conducted to ensure that all comments have been satisfactorily dealt with from the perspective of Westinghouse and the DOE. Following this review, final comments may be provided to the NRC if necessary.

1990 Plan

- No planned activities.

WBS Element 3.4.4 Final Rule Review

Responsibility of Westinghouse

Purpose

Review the final AP600 Design Certification Rule that is published in the Federal Register.

Approach

The Final Rule that is published in the Federal Register will be reviewed to ensure that the rule is correct, complete and will allow for proper referencing of the Design Certification Rule in subsequent license applications. If the Final Rule is inadequate in any way, then further actions would be contemplated at that time.

1990 Plan

- No planned activities.

1990 Program Work Plan

Cost Participation by WBS Elements 4

This section will be submitted later.

1990 Program Work Plan

Program Schedule 5

5.1 Summary Schedule Overview with 1990 Milestones

5.2 Detail Schedule for 1990

PROJECT OVER
PLOT OVER
PAGE 1/1 SHEET 1/1

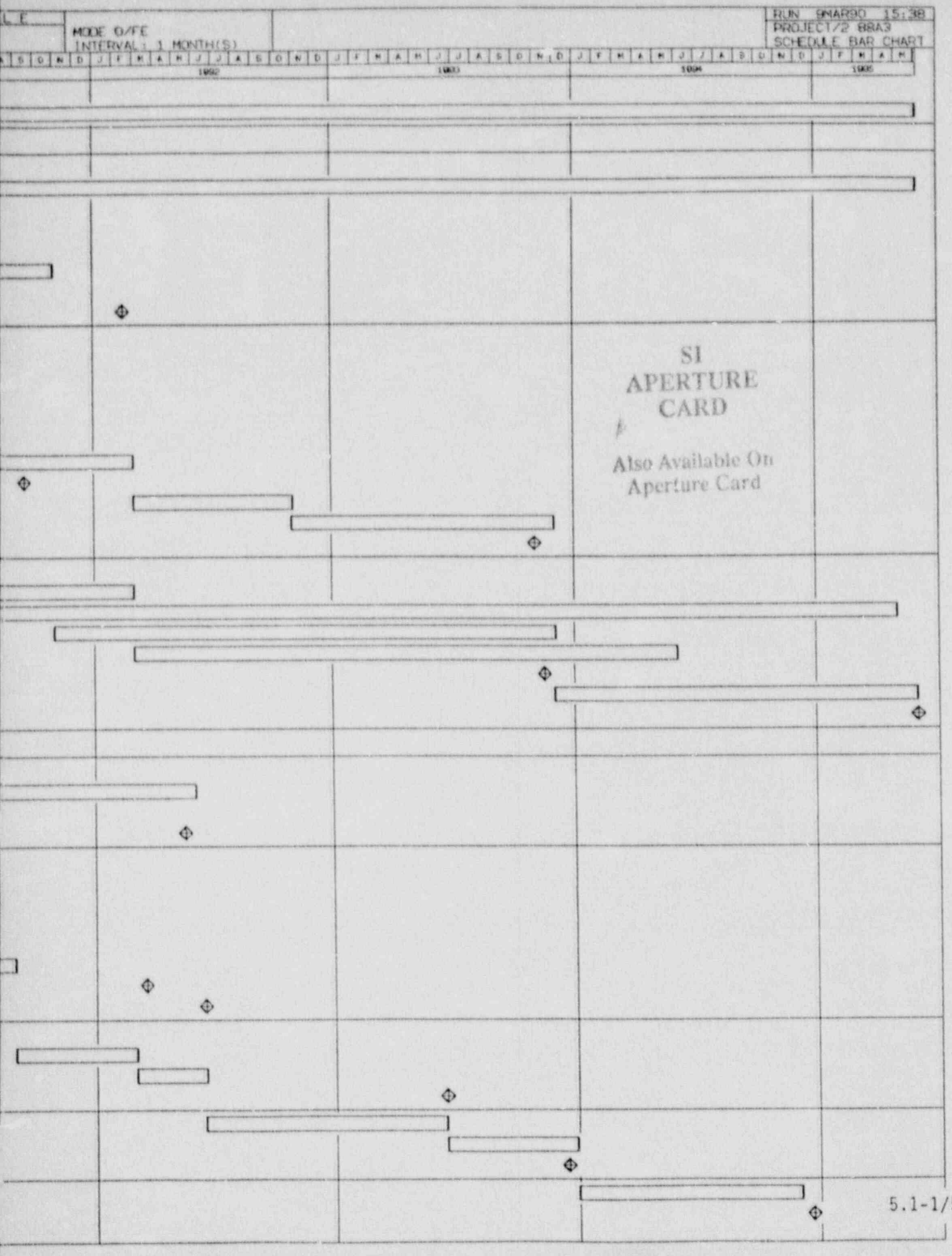
START 1JAN80
FINISH 2JUN85

AP600 LWR PLANT PROGRAM
OVER VIEW
CONTRACT NO. DE-AC03-90SF18495

WORKING SCHEDU
LINE BREAK ON
SORT BREAKS E START

J F M A M J J A S O N D J F M A M J J
1990 1991

1.0	PROGRAM MANAGEMENT
1.4	REQUEST VALIDATION OF MANAGEMENT CONTROL SYSTEM
2.1	EPRI, ALWR & URD REVIEWS
	DESIGN MANAGEMENT
	ISSUE RAM REQUIREMENTS
	ISSUE PLANT PARAMS & TOP LEV OPERATING CRITERIA
	SUBMIT OVERALL PLANT DESCRIPTION
	LONG LEAD HARDWARE PROCUREMENT DATA
	COMPLETE EVALUATIONS/EPRI, ALWR, & URD REVIEWS
	COMPLETE RAM EVALUATION
2.2	PLANT DESIGN CRITERIA
	ENG INTERFACE RQMNTS
	COMPLETE NUCLEAR SYS INTERFACE REQUIREMENTS
	PLANT SYSTEMS DESIGN
	ESTABLISH REACTOR COOLANT SYSTEM LAYOUT
	PLANT SYSTEMS ENG DSN REVIEWS
	ENG DSN DOCUMENTION
	COMPLETE PLANT SYS ENGINEERING DESIGN REVIEWS
	AUX EQUIP DSN TRANSIENTS
	PLANT SYS DETAILED DSN DOC & EQUIP PROCURE PLAN
	COMPLETE DESIGN DOCUMENTATION
2.3	COMPLETE PELIMINARY LAYOUT FOR NUCLEAR ISLAND
	NUC ISLAND STRUCT MECH. & MODULARIZATION
	TURB ISLAND STRUCT MECH & MODULE DSN & CONST DWG
	CONSTRUCTION PLAN OPTIMIZATION STUDIES
	NUC ISLAND DETAIL DSN & MODULE CONSTRUCT DRWGS
	COMPLETE CONSTRUCTION STUDIES
	CONSTRUCTION SCHEDULE & COST ESTIMATE
	COMPLETE CONSTRUCTION PACKAGE
2.4	ISSUE INITIAL SEISMIC ANALYSIS
2.6	OPTIMIZATION TESTING
	VERIFICATION TESTING
	COMPLETE OPTIMIZATION
	COMPLETE VERIFICATION
3.1	PREP ITAA GUIDELINE
	ESTABLISH LRB
	PRESENT AP600 TESTING PROGRAM PLAN TO NRC
	COMPLETE PRELIMINARY PRA STUDIES
	TRANSMIT DRAFT LRB FOR DOC INFORMATION
	DESIGN BASIS ACCIDENT ANALYSIS MODELING
	SUBMIT LRB TO NRC
	SUBMIT SSAR/ITAA/PRA
3.2	ISSUE ITAA CRITERIA GUIDELINES
	SAFETY ANALYSIS CALCULATIONS
	FINALIZE LICENSING DOCUMENTS
	ISSUE SER
3.3	DEFENSE OF APPLICATION
	ACRS REVIEW
	ISSUE FDA
3.4	RULEMAKING SUPPORT
	OBTAIN DESIGN CERTIFICATION



5.1-1/5.1-2

TABLE 5-1 1990 CONTRACT MILESTONES FOR THE AP600 PROGRAM

WBS Element	Milestone Description	Schedule Date
1.4	REQUEST VALIDATION OF MANAGEMENT CONTROL SYSTEM	AUGUST 15, 1990
2.1	ISSUE PLANT PARAMETERS AND TOP LEVEL OPERATING CRITERIA	JULY 31, 1990
2.1	SUBMIT OVERALL PLANT DESCRIPTION	DECEMBER 14, 1990
2.2	COMPLETE NUCLEAR SYSTEMS INTERFACE REQUIREMENTS	JUNE 1, 1990
2.2	ESTABLISH REACTOR COOLANT SYSTEM LAYOUT	NOVEMBER 1, 1990
2.3	COMPLETE PRELIMINARY LAYOUT FOR NUCLEAR ISLAND	JUNE 1, 1990
2.4	ISSUE INITIAL SEISMIC ANALYSIS	DECEMBER 14, 1990
3.1	PRESENT AP600 TESTING PROGRAM PLAN TO NRC	MAY 15, 1990
3.1	COMPLETE PRELIMINARY PRA STUDIES	JULY 31, 1990
3.1	TRANSMIT DRAFT LRB FOR DOE INFORMATION	SEPTEMBER 28, 1990
3.2	ISSUE ITAA CRITERIA GUIDELINES	SEPTEMBER 28, 1990

TABLE 5-2 AP600 PROGRAM MILESTONES

WBS Element	Milestone Description	Schedule Date
1.2	ISSUE RAM REQUIREMENTS	APRIL 30, 1990
1.2	COMPLETE RAM EVALUATION	FEBRUARY 14, 1992
1.4	REQUEST VALIDATION OF MANAGEMENT CONTROL SYSTEM	AUGUST 15, 1990
2.1	ISSUE PLANT PARAMETERS AND TOP LEVEL OPERATING CRITERIA	JULY 31, 1990
2.1	SUBMIT OVERALL PLANT DESCRIPTION	DECEMBER 14, 1990
2.1	COMPLETE EVALUATIONS/EPRI, ALWR, & URD REVIEWS	JUNE 14, 1991
2.2	COMPLETE NUCLEAR SYSTEMS INTERFACE REQUIREMENTS	JUNE 1, 1990
2.2	ESTABLISH REACTOR COOLANT SYSTEM LAYOUT	NOVEMBER 1, 1990
2.2	COMPLETE PLANT SYSTEMS ENGINEERING DESIGN REVIEWS	SEPTEMBER 16, 1991
2.2	COMPLETE DESIGN DOCUMENTATION	NOVEMBER 1, 1993
2.3	COMPLETE PRELIMINARY LAYOUT FOR NUCLEAR ISLAND	JUNE 1, 1990
2.3	COMPLETE CONSTRUCTION STUDIES	NOVEMBER 15, 1993
2.3	COMPLETE CONSTRUCTION PACKAGE	JUNE 1, 1995
2.4	ISSUE INITIAL SEISMIC ANALYSES	DECEMBER 14, 1990
2.6	COMPLETE OPTIMIZATION TESTS	APRIL 1, 1991
2.6	COMPLETE VERIFICATION TESTS	MAY 15, 1992
3.1	PRESENT AP600 TESTING PROGRAM PLAN TO NRC	MAY 15, 1990
3.1	COMPLETE PRELIMINARY PRA STUDIES	JULY 31, 1990
3.1	TRANSMIT DRAFT LRB FOR DOE INFORMATION	SEPTEMBER 28, 1990
3.1	SUBMIT LRB TO NRC	MARCH 16, 1992
3.1	SUBMIT SSAR/ITAA/PRA	JUNE 15, 1992
3.2	ISSUE ITAA CRITERIA GUIDELINES	SEPTEMBER 28, 1990
3.2	ISSUE SER	JUNE 15, 1993
3.3	ISSSUE FDA	DECEMBER 15, 1993
3.4	OBTAIN DESIGN CERTIFICATION	DECEMBER 20, 1994

PROJECT HB1 PLOT DOE PAGE 1/1 SHEET 1/3	START 1NOV89 FINISH 28AUG95	AP600 LWR PLANT PROGRAM LEVEL 2 ACTIVITY CONTRACT NO. DE-AC03-90SF18495	W C LINE B SORT

JAN | FEB | MAR | APR

1.1	QUALITY ASSURANCE PLAN
1.2	RAM PLAN
1.3	CONFIGURATION MANAGEMENT PLAN
	CONFIGURATION MANAGEMENT PROCEDURES
1.4	PROJECT MANAGEMENT PLAN
	1990 COST PARTICIPATION PLAN
	1990 ANNUAL WORK PLAN
	ISSUE FIRST DOE REQUIRED MONTHLY REPORT
	1991 COST PARTICIPATION PLAN
	CSCSC PROCEDURES
	REQUEST VALIDATION OF MANAGEMENT CONTROL SYSTEM
	1991 ANNUAL WORK PLAN
1.6	SUBCONTRACTOR MANAGEMENT PLAN
2.1	UPDATE PLANT PARAMETERS LIST
	REVIEW EPRI ALWR PASSIVE PLANT RQMT AS AVAILABLE
	DEV ACCESS, SECURITY, CONFIG MGMNT DATA BASE
	SELECT ENGINEERING DATA BASE MANAGER
	DEVELOP PLANT LEVEL RAM RQMNTS & GOALS
	DSN BASIS:UPDATE PLANT DSN CRITERIA DOC
	DEV PREL EVAL OF OCCUPATION RADIATION EXPOSURE
	ISSUE PLANT PARAMETERS & TOP LEVEL OPER CRIT
	GENERATE RAM CRITICAL ITEMS LIST
	PREPARE OVERALL PLANT DESCRIPTION RPT
	INITIAL UTILITY WORKSHOPS COMPLETED
	SUBMIT OVERALL PLANT DESCRIPTION
2.2	DEVELOP REACTOR GENERAL ASS'Y DRAWING
	DEVELOP REACTOR SYS FUNCT RQMNTS DOC
	ESTABLISH REACTOR COOLANT SYSTEM LOOP LAYOUT
	AUXIL FLUID PREL SYS INTERFACE RQMTS
	PREL NUCLEAR FLUID INTERFACE RQMNT
	ESTABLISH PRELIM RCS INTERFACE RQMNT
	DEVELOP OVERALL I&C SYS ARCHITECTURE RQMNT
	PREL ELEC SYSTEM INTERFACE REQUIREMENTS
	COMPLETE NUCLEAR SYS INTERFACE RQMNT

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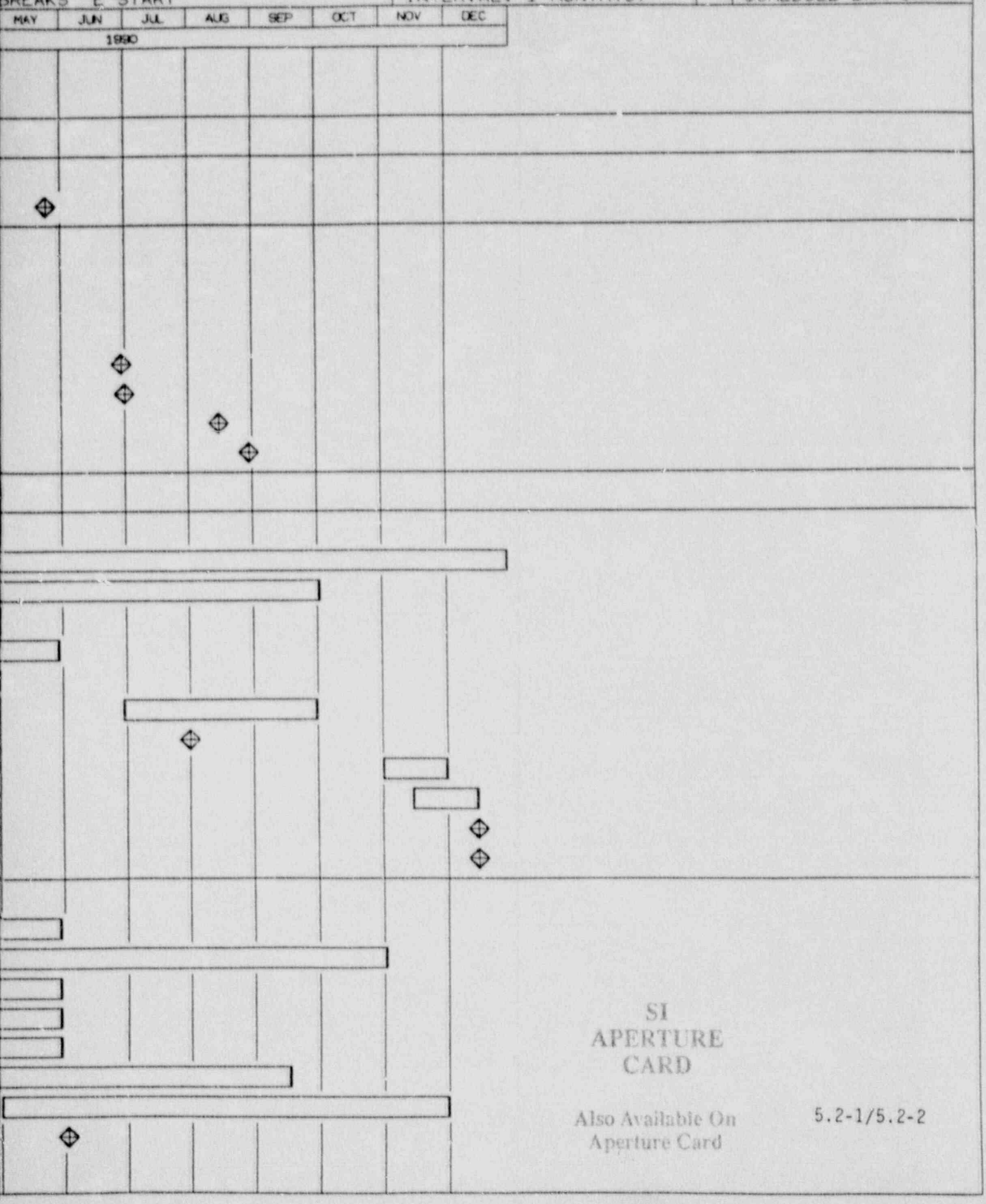

5.2-1/5.2-2

PROJECT HB1
PLOT DOE
PAGE 1/1 SHEET 2/3

		JAN	FEB	MAR	APR
2.2	ESTABLISH PRELIMINARY HVAC INTERFACE ROMNTS				
	PREL ALARM SYS FUNCTIONAL ROMNT				
2.3	DEVELOP MODEL PLAN				
	DEV GENERAL MODULARIZATION CRITERIA				
	PREP CONST. LOGIC FOR CRITICAL PATH ACTIVITIES				
	PERFORM PRELIMINARY SECURITY & SAFETY REVIEW				
	DESIGN KEY NUCLEAR ISLAND MODULES				
	PREPARE CONSTRUCTION WORK BREAKDOWN STUDIES				
	COMPLETE PRELIMINARY LAYOUT OF NI				
	CREATE INITIAL 3D CADD MODEL OF NI				
	UPDATE PLANT COST ESTIMATE FOR MAJOR CHANGES				
	ISSUE REVISED GENERAL ARRANGEMENT DRAWINGS				
2.4	DEV STRUCTURAL DSN CRITERIA				
	ESTABLISH DESIGN CRITERIA FOR SEISMIC ANALYSIS				
	ESTABLISH SOIL STRUCTURE INTERACTION METHOD				
	PREL NI CONCRETE OUTLINE DRAWINGS				
	SELECT TYPE OF SRUCTURE FOR ACC CONTROL BLDG				
	SELECT TURBINE FOUNDATION TYPE				
	SELECT TYPE OF ANNEX BLDG STRUCTURE				
	DEVELOP NUCLEAR ISLAND SEISMIC MODEL				
	PRELIMINARY TI STEEL FRAMING DRAWINGS				
	PREL NI STRUCT MODULE & STEEL FRAME DESIGN				
	COMPLETE SEISMIC ANALYSIS				
2.5	ESTABLISH SPECIFIC BASES FOR DESIGN TRANSIENTS				
	DEV PREL CTRL SYS FUNCT ROMNTS/PREL FUNCT DIA				
	DEV SOURCE TERMS FOR VARIOUS PLANT CONDITIONS				
	ESTABLISH FRAMEWORK FOR PREP OF EMERG OPER PROC				
	DEV PREL PROT SYS FUNCT ROMNTS/PREL FUNCT DIA				
	DEV AP600 LOFTRAN THERM/HYD COMPUTER CODE MDL				
	DEVELOP DESIGN CRITERIA FOR HAZARDS				
	EMERG OPER PROC DEV HIGH LEVEL ACTION STRAT				
	DEV DESIGN GUIDES TO MINIMIZE IMPACT OF HAZARDS				
	CONFIRM MAJOR STRUCTURE SHIELD CONFIGURATION				
	DEV PRELIMINARY RADIATION ZONING DIAGRAMS				
2.6	PCCS HEAT TRANSFER TEST-VESSEL PROCUREMENT SPEC				

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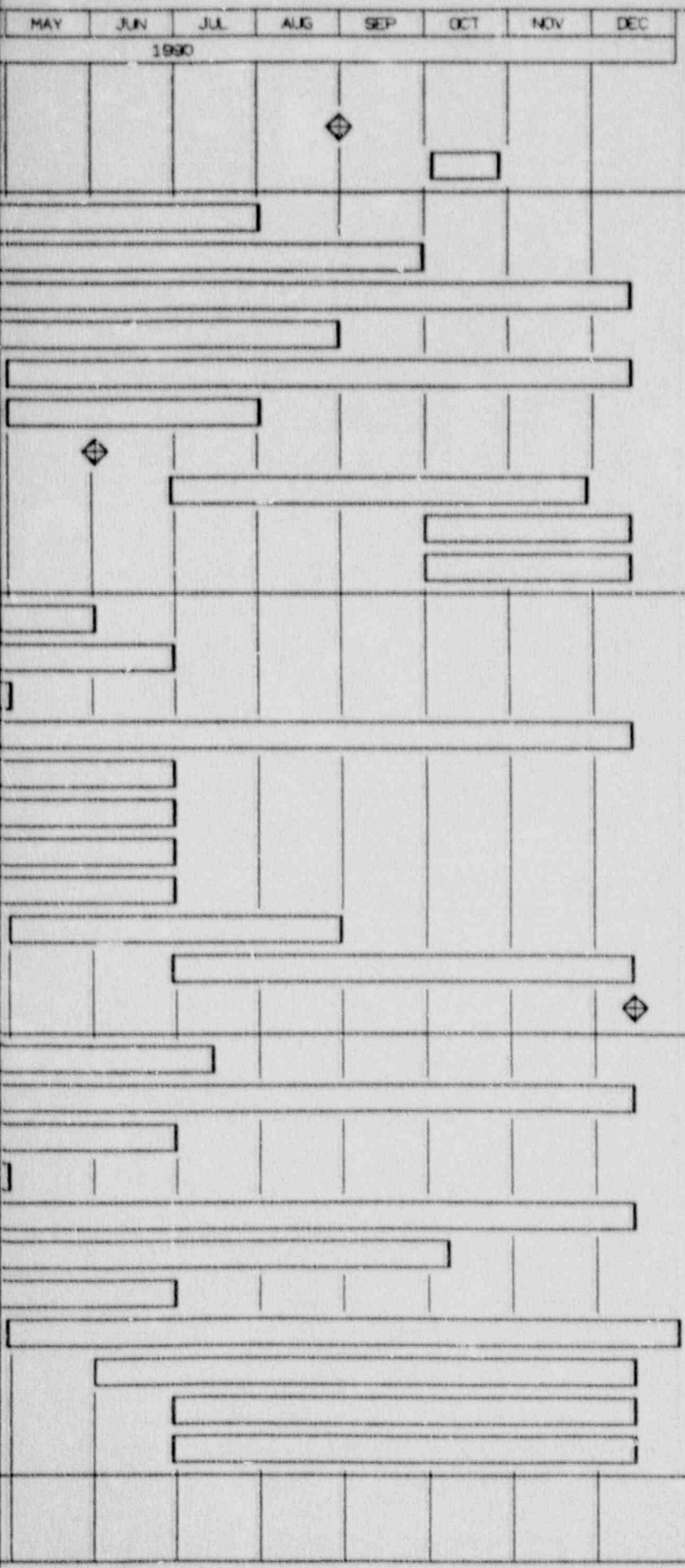

5.2-3/5.2-4

PROJECT HB1
PLOT DOE
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JAN | FEB | MAR | APR

2.6	INTEGRAL CONTAINMNT COOLING TEST-PHS 2 TEST SPEC
	PRHR HEAT EXCHANGER TEST-PHASE 1 TEST REPORT
	PSIS CHECK VALVE TEST-FINAL TEST SPEC
	CORE MAKEUP TANK TEST-FINAL TEST SPEC
	RCP JOURNAL BEARING PHASE 1 TEST REPORT
	AUTO DEPRESS TEST-FINAL TEST SPEC
	PRHR HEAT EXCHANGER TEST-PHASE 2 TEST SPEC
	RCP/SG AIRFLOW TEST-TESTING
	PCCS WATER DISTRIBUTION TEST-TEST REPORT
	DNB TEST-PREPARE TEST SPEC
	PCCS WIND TUNNEL TEST-TEST REPORT
	INCORE INSTR EM INTER TEST-TEST/REPORT
3.1	DSGN BASIC ACCIDENT ANALYSIS PREL SAFETY STUDY
	PRESENT AP600 TESTING PLAN TO NRC
	COMPLETE PRELIMINARY PRA STUDIES
	TRANSMIT DRAFT LRB FOR DOE INFORMATION
3.2	ISSUE ITAA CRITERIA GUIDELINES

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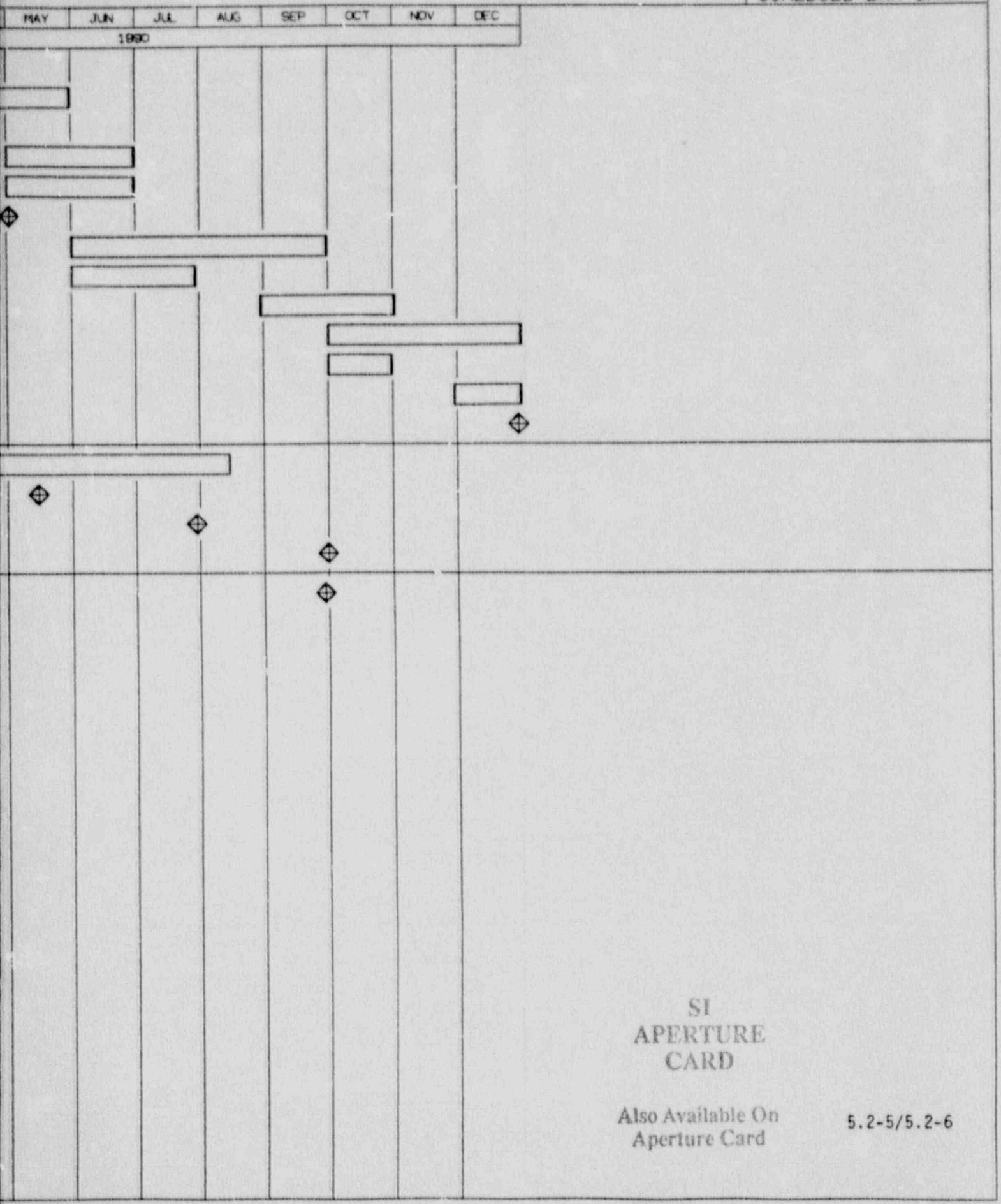

5.2-5/5.2-6

1990 Program Work Plan

Cost Plan 6

This section will be submitted later.

1990 Program Work Plan

Labor Plan 7

Section 7.0 will be submitted under separate cover.