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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: R. W. BORCHARDT

SUBJECT: WESTINGHOUSE RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION ON THE AP600

Dear Mr. Borchardt:

Enclosed are three copies of the Westinghouse responses to NRC requests for additional information on the AP600 from your letters of March 7, 1994 and March 16, 1994.

A listing of the NRC requests for additional information responded to in this letter is contained in Attachment A.

These responses are also provided as electronic files in WordPerfect 5.1 format with Mr. Hasselberg's copy.

If you have any questions on this material, please contact Mr. Brian A. McIntyre at 412-374-4334.

Nicholas J. Liparulo, Manager
Nuclear Safety & Regulatory Activities

/nja

Enclosure

cc: B. A. McIntyre - Westinghouse
F. Hasselberg - NRR

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NTD-NRC-94-4128
ATTACHMENT A
AP600 RAI RESPONSES
SUBMITTED MAY 11,1994

RAI No.	Issue
100.011	Classification of SSCs
220.053	Rationale for 6 ft thick foundation
220.060	Wind loads in Level A&C combinations
220.062	Descriptions for polar crane system
220.067	Operating pressure in load combinations
220.079	IRWST design information in SAR
220.087	Energy component for embedment effect
220.088	Use of coated rebar
220.090	Type and characteristics of water seals
230.050	Auditable trail for final seismic calculations
230.053	Inclusion of other site conditions
230.055	Use of SASSI
230.062	Validity of fixed base seismic analysis
230.069	Shallow soil site conditions
230.070	Procedure for developing seismic response envelope
230.079	Use of Seed-Idriss 1970 curves in SSI analyses
230.080	Adequacy of using only 3 soil site conditions
230.081	Use of computer code SAP or BSAP
230.084	Additional information in Section 3.7.2.1.1
231.015	Geography & demography limits for a site
231.016	Flood level to plant grade design features
231.022	SSI studies for the rock model
231.030	Impact of non-vertically incident ground motion
231.031	SSAR Appendix 2A.2

Question 100.11

Provide a matrix indicating which non-safety-related structures, systems, and components (SSCs) of the AP600 listed in Table 3.2-3 of the standard safety analysis report (SSAR) are (1) Quality Class D because they contain radioactivity (in accordance with Regulatory Guide 1.26), (2) Quality Class D defense-in-depth (DID) systems that directly act to prevent unnecessary actuation of the passive safety-related systems or support those non-safety-related SSCs that directly act to prevent unnecessary actuation of the passive safety-related systems, or (3) risk-significant as identified through the analysis process described in the draft Commission paper on regulatory treatment of non-safety-related systems (RTNSS) (issued September 10, 1993). Are there other non-safety-related SSCs that are not listed in Table 3.2-3 that have been determined to be risk significant through the RTNSS process?

Response:

The attached table identifies those functions of AP600 systems that are safety-related, nonsafety-related defense-in-depth, Regulatory Guide 1.26, and regulatory treatment of nonsafety-related systems (RTNSS) important functions.

Column 1

This column identifies those functions that are safety-related. Equipment classified as safety-related is relied upon to remain functional during or following a design basis event to provide a safety-related function. SSAR Table 3.2-3 identifies the AP600 components that have been classified as safety-related.

Column 2

This column identifies those functions that have been identified as important in the AP600 implementation of the RTNSS process. The RTNSS process and the results of the AP600 implementation of the process are contained in WCAP-13856, "AP600 Implementation of the Regulatory Treatment of Nonsafety-Related Systems Process." Where additional regulatory oversight has been proposed in WCAP-13856, the components that perform these functions are classified as AP600 equipment class D in SSAR Table 3.2-3.

As discussed in WCAP 13856, additional regulatory oversight for the nonsafety-related components that must operate to support power production, beyond that provided via the SSAR design details and the existing operational controls on current plants, will not provide significant PRA benefit. Therefore, additional regulatory oversight is not proposed for these nonsafety-related components that are required to operate during power production and these components have not been classified as AP600 equipment class D components.

Column 3

This column identifies those functions that are not included in AP600 Class A, B, C, or AP600 defense-in-depth functions but are classified as Regulatory Guide 1.26, Quality Group D functions because components within the associated systems may contain radioactive material. The components that perform these functions are classified as AP600 equipment class D in SSAR Table 3.2-3.

Column 4

This column identifies those functions identified as AP600 nonsafety-related defense-in-depth functions. The systems that perform defense-in-depth functions are those nonsafety-related active systems that:

1. Act to prevent unnecessary actuation of the safety-related passive systems

2. Provide support functions (such as heat removal, electrical power, or instrumentation and control) to the nonsafety-related systems required by the first criteria.

The components utilized for these functions are classified as AP600 equipment class D in SSAR Table 3.2-3.

SSAR Revision:

The first paragraph in the Containment High Range Radiation Monitor subsection of Section 11.5.2.3.2 on page 11.5-6 should be revised at follows:

Containment High Range Radiation Monitor

The containment high range radiation monitors ~~has~~ (detectors ~~RMS-JE-RE110~~PXS-JE-RE160, ~~RMS-JE-RE111~~PXS-JE-RE161, ~~RMS-JE-RE112~~PXS-JE-RE162, and ~~RMS-JE-RE113~~PXS-JE-RE163) measure and record the radiation from the radioactive gases in the containment atmosphere. The local radiation processors receive Class 1E power.

Table 11.5-1 on page 11.5-12 should be modified as follows:

Table 11.5-1

Radiation Monitor Detector Parameters

Detector	Type	Service	Isotopes	Nominal Range
BDS-JE-RE007	γ	Steam Generator Blowdown	Cs-137	1.0E-6 to 1.0E-1 μCi/cc
CCS-JE-RE001	γ	Component Cooling Water System	Cs-137	1.0E-8 to 1.0E-2 μCi/cc
CVS-JE-RE003	γ	Reactor Coolant Letdown	Cs-137	1.0E-4 to 1.0E+2 μCi/cc
RMS-JE-RE001	β	Plant Vent Particulate	Sr-90 Cs-137	1.0E-13 to 1.0E-7 μCi/cc
RMS-JE-RE002	γ	Plant Vent Iodine	I-131	1.0E-12 to 1.0E-6 μCi/cc
RMS-JE-RE003	β	Plant Vent Gas (Normal Range)	Kr-85 Xe-133	1.0E-7 to 1.0E-2 μCi/cc
RMS-JE-RE005	β	P.V. Extended Range Gas (Accident Range)	Kr-85 Xe-133	1.0E-4 to 1.0E+5 μCi/cc
RMS-JE-RE024	β	Containment Atmosphere Particulate	Sr-90 Cs-137	1.0E-13 to 1.0E-7 μCi/cc
RMS-JE-RE025	γ	Containment Atmosphere Iodine	I-131	1.0E-12 to 1.0E-6 μCi/cc
RMS-JE-RE026	β	Containment Atmosphere Gas	Kr-85 Xe-133	1.0E-7 to 1.0E-2 μCi/cc
~~RMS-JE-RE110~~ PXS-JE-RE160	γ	Containment High Range	Kr-85 Xe-133	1.0E-0 to 1.0E+7 R/hr
~~RMS-JE-RE111~~ PXS-JE-RE161	γ	Containment High Range	Kr-85 Xe-133	1.0E-0 to 1.0E+7 R/hr
~~RMS-JE-RE112~~ PXS-JE-RE162	γ	Containment High Range	Kr-85 Xe-133	1.0E-0 to 1.0E+7 R/hr
~~RMS-JE-RE113~~ PXS-JE-RE163	γ	Containment High Range	Kr-85 Xe-133	1.0E-0 to 1.0E+7 R/hr
SGS-JE-RE026	γ	Main Steam Line	CS-137	1.0E-1 to 1.0E+3 μCi/cc
SGS-JE-RE027	γ	Main Steam Line	Cs-137	1.0E-1 to 1.0E+3 μCi/cc

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Steam Generator Blowdown (BDS)	May contain radioactive material				Yes	
Compressed and Instrument Air (CAS)	Containment isolation	Yes				
Component Cooling Water (CCS)	Containment isolation	Yes				
	Provides cooling for normal RHR heat exchangers and pumps when the reactor coolant system pressure and temperature are below 450 psig and 350 F					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Component Cooling Water (CCS) (continued)	Provides cooling for normal RHR heat exchangers and pumps during reduced reactor coolant inventory operations in Modes 5 or 6.		Yes	Yes		Yes
	Provides cooling for the miniflow heat exchangers of the chemical and volume control system makeup pumps					Yes
	Provides cooling for the spent fuel pit heat exchangers for heat removal from the spent fuel pit					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Containment (CNS)	Provide the isolation function by establishing a barrier between the containment environment and the outside environment	Yes				
Condensate (CDS)	Provide continuous operation during power production to prevent plant trips		Yes	No		
Condensate Polishing (CPS)	May contain radioactive material (resin disposal)				Yes	
Chemical and Volume Control (CVS)	Reactor coolant system pressure boundary preservation, including isolation of normal chemical and volume control system letdown from the reactor coolant system	Yes				

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Chemical and Volume Control (CVS) (continued)	Containment isolation	Yes				
	Termination of inadvertent reactor coolant system boron dilution	Yes				
	Isolation of excessive makeup	Yes				
	Supply makeup and boration to the reactor coolant system					Yes
	Supply coolant to the pressurizer auxiliary spray line					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Diverse Actuation (DAS)	Provide automatic actuation signals for a reactor trip and a selected set of engineered safeguard features as a result of certain plant parameters exceeding setpoints.		Yes (Turbine trip / PRHR actuation only)	Yes (Turbine trip / PRHR actuation only)		Yes
	Provide the capability for independent manual actuation of a reactor trip and a selected set of engineered safeguard features.					Yes
	Provide independent indication of selected plant parameters.					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Data Display and Processing (DDS)	Provide display of plant parameters for defense-in-depth functions.					Yes
	Provide an alternative means of displaying information from the protection and safety monitoring system.					Yes
Standby Diesel and Auxiliary Boiler Fuel Oil (DOS)	Supply diesel fuel for the defense-in-depth function of the onsite standby power system					Yes

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Demineralized Water Transfer and Storage (DWS)	Containment isolation	Yes				
	Provide water supply to support startup feedwater					Yes
Main ac Power (ECS)	Provide the capability for interrupting the power to the reactor coolant pump motors.	Yes				
	Provide the capability for distributing non-Class 1E ac power from offsite and onsite sources to selected components in the defense-in-depth systems.					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Main ac Power (ECS) (continued)	Provide the capability for supplying and distributing non-Class 1E ac power to the normal residual heat removal system and required support systems during reduced reactor coolant inventory operations in Modes 5 or 6.		Yes	Yes		Yes
Non-Class 1E dc and UPS (EDS)	Provide electrical power for control and monitoring of the defense-in-depth functions		Yes (Turbine trip / PRHR actuation only)	Yes (Turbine trip / PRHR actuation only)		Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Plant Lighting (ELS)	Provide emergency lighting in the main control room and the remote shutdown workstation area to illuminate these areas for emergency operations upon loss of normal lighting					Yes
Fuel Handling and Refueling (FHS)	Prevent dropping or jamming of fuel assemblies during transfer operation	Yes				
	Prevent dropping of fuel handling devices during the fuel transfer operation	Yes				
	Containment isolation	Yes				

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Fuel Handling and Refueling (FHS) (continued)	Prevent criticality during fuel handling operations by maintaining the geometrically safe configuration of the fuel	Yes				
	Store new fuel in a manner to maintain the required degree of subcriticality	Yes				
	Store spent fuel in a manner to maintain the required degree of subcriticality	Yes				
	Limit spent fuel lift height so that the minimum required depth of water shielding is maintained					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Fire Protection (FPS)	Containment isolation	Yes				
	Provide manual firefighting equipment in areas containing equipment required for safe shutdown					Yes
Main and Startup Feedwater (FWS)	Feedwater isolation by tripping of the main feedwater pumps					Yes
	Provide startup feedwater for heat removal from the reactor coolant system (startup feedwater)					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Main and Startup Feedwater (FWS) (continued)	Provide continuous operation during power production to prevent plant trips (main feedwater)		Yes	No		
Class 1E dc and UPS (IDS)	Provide dc power to the safe shutdown loads for 24 hours (Divisions A, B, C, and D) and for 24 and 72 hours (Divisions B and C) respectively, as required, without the support of the battery chargers during a loss of all ac power sources	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Class 1E dc and UPS (IDS) (continued)	Provide electrical isolation between the main ac power system and Class 1E 125 vdc circuits	Yes				
	Provide ac power to the instrument and control devices, and the emergency lighting	Yes				
	Provide electrical isolation between the main ac power system and Class 1E UPS circuits	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Class 1E dc and UPS (IDS) (continued)	Supply the continuous load demand while maintaining the associated batteries in charged condition					Yes
	Provide backup power to the Class 1E UPS loads if one of the inverters in that division is not available					Yes
Incore Instrumentation (IIS)	Provide reactor coolant system pressure boundary integrity	Yes				
	Provide the protection and safety monitoring system with core exit temperature signals	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Mechanical Handling (MHS)	Prevent uncontrolled lowering of heavy loads in safety-related areas (containment polar crane and the spent fuel shipping cask crane)	Yes				
Main Steam (MSS)	Provide continuous operation during power production to prevent plant trips		Yes	No		
Main Turbine (MTS)	Provide continuous operation during power production to prevent plant trips		Yes	No		

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Main Turbine (MTS) (continued)	During design basis accidents, the main turbine system supplements the steam generator system to prevent excessive steam generator blowdown by isolating the main steam lines.					Yes
Passive Containment Cooling (PCS)	Provide containment heat removal capability following a postulated design basis accident. The PCS removes containment heat to limit containment peak pressure to less than the design pressure.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Passive Containment Cooling (PCS) (continued)	Reduce containment pressure to less than one half of containment design pressure within 24 hours following a postulated loss-of-coolant accident	Yes				
	Provide containment heat removal for at least 72 hours with no operator actions or outside assistance such that the containment design pressure will not be exceeded.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Passive Containment Cooling (PCS) (continued)	Provide a temporary, safety-related cooling water connection for continued containment cooling water flow following water storage tank depletion after 72 hours.	Yes				
	The passive containment cooling water storage tank provides a water source for the fire protection system.					Yes
Plant Control (PLS)	Provide control signals for defense-in-depth components					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Plant Control (PLS) (continued)	Validate signals received from the protection and safety monitoring system to prevent the failure of a sensor or division in protection and safety monitoring system from propagating into the plant control system					Yes
	Provide continuous operation during power production to prevent plant trips		Yes	No		
Protection and Safety Monitoring (PMS)	Provide tripping of the reactor by opening the reactor trip breakers	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Protection and Safety Monitoring (PMS) (continued)	Provide actuation of the engineered safety features equipment	Yes				
	Provide safety-related plant parameter monitoring prior to, during, and after an accident or plant transient	Yes				
Primary Sampling (PSS)	Containment isolation	Yes				
	Obtain samples from the reactor coolant system loops and the containment recirculation inlet.					Yes

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Passive Core Cooling (PXS)	Provide emergency core decay heat removal	Yes				
	Provide emergency reactor coolant system makeup and boration	Yes				
	Provide safety injection to the reactor coolant system to provide core cooling for the complete range of loss-of-coolant accidents, up to and including the double-ended rupture of the largest reactor coolant system piping.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Passive Core Cooling (PXS) (continued)	Provide for chemical addition to the containment during post-accident conditions to establish floodup chemistry conditions that support radionuclide retention in the event of high radioactivity in containment.	Yes				
	Measure the radioactivity levels in the containment atmosphere and provide signals to the protection and safety monitoring system	Yes				
Reactor Coolant (RCS)	Provide a controlled, sequenced depressurization of the reactor coolant system.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Reactor Coolant (RCS) (continued)	Provide the pressure boundary for the reactor coolant.	Yes				
	Provide the pressure boundary for the secondary fluid and the connection to the steam generator system (the shell side of the steam generator).	Yes				
	Provide circulation of coolant when the reactor coolant pumps do not operate.	Yes				
	Provide flow coast down on loss of power to the reactor coolant pumps.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Reactor Coolant (RCS) (continued)	Provide overpressure protection.	Yes				
	Provide circulation of reactor coolant through the reactor vessel and the primary side of the steam generator transferring heat to the secondary side of the steam generator.					Yes
	Maintain the system pressure during operation. During the reduction or increase of plant load, the pressurizer accommodates volume changes in the reactor coolant and limits pressure transients.					Yes

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Radiation Monitoring (RMS)	Measure, display, and record the concentration of radioactive materials in the plant vent effluent to the atmosphere and provide alarms and indication in the main control room					Yes
	Measure, display, and record the amount of radioactivity in the condenser air removal discharge path to the atmosphere and provide alarms and indication in the main control room					Yes
Normal Residual Heat Removal (RNS)	Reactor coolant system pressure boundary	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Normal Residual Heat Removal (RNS) (continued)	Containment isolation	Yes				
	Remove heat from the reactor coolant system during shutdown operation at reduced pressure and temperature					Yes
	Remove heat from the reactor during reduced reactor coolant inventory operations in Modes 5 or 6.		Yes	Yes		Yes
	Provide low temperature overpressure protection for the reactor coolant system					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Normal Residual Heat Removal (RNS) (continued)	Provide low pressure makeup to the reactor coolant system and remove heat from the reactor coolant system following actuation of the automatic depressurization system.					Yes
Reactor (RXS)	Reactor coolant system pressure boundary	Yes				
	Provide support and alignment for the reactor internals and core.	Yes				
	Direct main coolant flow through the core.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Reactor (RXS) (continued)	Provide support and alignment for the control rod drive mechanisms.	Yes				
	Provide support and alignment for the in-core instrumentation assemblies.	Yes				
	Initiate insertion of the control rod drive assembly on electrical power interruption.	Yes				
Spent Fuel Pit Cooling (SFS)	Containment isolation.	Yes				

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Spent Fuel Pit Cooling (SFS) (continued)	Provide heat removal from the spent fuel using the initial inventory of water in the spent fuel pit.	Yes				
	Provide safety-related connections used for temporary emergency makeup to the spent fuel pit.	Yes				
	Provide for heat removal from the spent fuel stored in the spent fuel pit by pumping the water from the pit through a heat exchanger, and then returning the water to the pit.					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Steam Generator (SGS)	Provide overpressure protection for the steam generator secondary side, as well as portions of the main steam line, feedwater lines and blowdown lines, by means of the safety relief valves for events that result in steam generator pressure transients.	Yes				
	Provide for heat removal from the reactor coolant by releasing the steam generated from the steam generator inventory to the atmosphere via the safety valves.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Steam Generator (SGS) (continued)	Provide the capability to isolate main feedwater, startup feedwater, blowdown, and main steam lines to prevent excessive steam generator blowdown and excessive feedwater flow from the main and startup feedwater system during design basis accidents.	Yes				
	Containment isolation.	Yes				
	Provide feedwater and startup feedwater isolation to avoid steam line flooding after a steam generator tube rupture accident.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Steam Generator (SGS) (continued)	Provide decay heat removal capability during shutdown operations by delivery of startup feedwater flow to the steam generator and venting of steam from the steam generators to the atmosphere via the power-operated relief valves.					Yes
Service Water (SWS)	Provide the capability for removing heat from the component cooling water system.					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Service Water (SWS) (continued)	Provide the capability for removing heat from the spent fuel pool via the spent fuel cooling and component cooling water systems.					Yes
	Provide the capability for decay heat removal at shutdown conditions through the normal residual heat removal and component cooling systems.					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Service Water (SWS) (continued)	Provide the capability for decay heat removal through the normal residual heat removal and component cooling systems during reduced reactor coolant inventory operations in Modes 5 or 6.		Yes	Yes		Yes
Main Turbine Control and Diagnostics (TOS)	Provide continuous operation during power production to prevent plant trips (turbine control)		Yes	No		

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Radiologically Controlled Area Ventilation (VAS)	May contain radioactive material				Yes	
Nuclear Island Nonradioactive Ventilation (VBS)	Main control room envelope isolation.	Yes				
	Provide ventilation and cooling to the main control room envelope, Class 1E instrumentation and control rooms, Class 1E dc equipment rooms, and Class 1E battery rooms.					Yes

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Nuclear Island Nonradioactive Ventilation (VBS) (continued)	Provide filters to limit the airborne radioactivity level within the main control room envelope.					Yes
	Measure the concentration of radioactivity in the main control room normal supply air and provide a signal to the plant control system					Yes
	Measure the concentration of radioactivity in the main control room normal supply air and provide signals to the protection and safety monitoring system	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Main Control Room Habitability (VES)	Provide breathable air for the occupants of the main control room for at least 72 hours via compressed air storage tanks.	Yes				
	Provide a safety-related refilling connection for the compressed air storage tanks.	Yes				
	Provide pressurization of the main control room envelope.	Yes				

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Main Control Room Habitability (VES) (continued)	Provide passive heat sinks for the main control room, the protection and safety monitoring system instrumentation and control rooms, and the Class 1E dc equipment rooms. The heat sinks for these rooms provide cooling capacity for at least 72 hours.	Yes				
Containment Air Filtration (VFS)	Containment isolation.	Yes				
	May contain radioactive material				Yes	

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Containment Hydrogen Control (VLS)	Provide containment hydrogen concentration measurement.	Yes				
	Provide hydrogen recombiners to control containment long term hydrogen concentrations.	Yes				
	Provide hydrogen igniters to control hydrogen concentration in excess of the recombiner capability.					Yes
Containment Leak Rate Test (VUS)	Containment isolation	Yes				
Central Chilled Water (VWS)	Containment isolation.	Yes				

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Central Chilled Water (VWS) (continued)	Provide chilled water to support the nuclear island nonradioactive ventilation system cooling of the main control room envelope, Class 1E instrumentation and control rooms, Class 1E dc equipment rooms, and the Class 1E battery rooms.					Yes
	Provide chilled water to support the cooling functions of the compartment unit coolers for the normal residual heat removal system pump.					Yes

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Central Chilled Water (VWS) (continued)	Provide chilled water to support the cooling functions of the compartment unit coolers for the chemical and volume control system makeup pump.					Yes
Annex/Auxiliary Building Nonradioactive Ventilation (VXS)	Provide ventilation of the electrical switchgear rooms that contain the diesel bus switchgear.					Yes
Diesel Generator Building Ventilation (VZS)	Provide ventilation, cooling, and heating of the diesel generator building to support operation of the onsite standby power system.					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Gaseous Radwaste (WGS)	May contain radioactive material				Yes	
Liquid Radwaste (WLS)	Containment isolation.	Yes				
	May contain radioactive material				Yes	
	Measure and record the concentration of radioactive materials in the liquid discharge to the environment and provide alarm and indication in the main control room					Yes
Radioactive Waste Drain (WRS)	May contain radioactive material				Yes	

AP600

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Solid Radwaste (WSS)	May contain radioactive material				Yes	
Waste Water (WWS)	May contain radioactive material				Yes	
Transmission Switchyard and Offsite Power (ZBS)	Provide electrical power to onsite equipment needed to support decay heat removal operation during reduced reactor coolant inventory operations in Modes 5 or 6.		Yes	Yes		Yes
	Provide electrical power to onsite equipment needed to support defense-in-depth system functions.					Yes

System	Function	1 Safety-related	2 RTNSS		3 Nonsafety-related, RG 1.26 Quality Group D, AP600 Equipment Class D	4 Nonsafety-related, Defense-in-Depth, AP600 Equipment Class D
			Nonsafety-related, RTNSS Important (WCAP-13856)	Additional Regulatory Oversight Proposed (WCAP-13856)		
Onsite Standby Power (ZOS)	Supply ac power to the Class 1E dc and UPS system.					Yes
	Supply ac power to selected electrical components of the plant defense-in-depth, nonsafety-related systems.					Yes
	Supply ac power to onsite equipment needed to support decay heat removal operation during reduced reactor coolant inventory operations in Modes 5 or 6.		Yes	Yes		Yes

AP600

Question 220.53

Provide the rationale that the use of 6-foot thick foundation, especially the foundation mat underneath the containment vessel, is adequate. (Conventional containment building foundation is 10-foot thick)

Response:

The design of the nuclear island basemat is described in SSAR Subsection 3.8.5. The analyses described therein demonstrate that the design meets the specified acceptance criteria.

The basemat under the auxiliary building is stiffened by the vertical shear walls which are spaced at approximately 18 to 26 feet. Consequently, the spans of the 6-foot thick basemat for resisting the applied forces are relatively short. Most of the walls extend from elevation 66'-6"(top of the basemat) to elevation 100' (grade), and a number extend the entire height of the auxiliary building. These walls provide stiffening to the basemat. In effect, the basemat can be considered to be equivalent to a basemat approximately 40-feet thick.

Typical conventional containment building foundation thicknesses are in the range of 9 to 10 feet thick. In a separate, prestressed containment building, the foundation thickness is normally governed at the foundation/wall interface by the soil pressure due to seismic loads and the containment pressure loads. In the case of the AP600, the soil pressure due to dead and seismic loads is minimized due to the large footprint of the common nuclear island basemat. The bottom head of the steel containment vessel is able to resist the containment internal pressure. It is also noted that due to the ellipsoidal bottom head of the steel containment vessel, the basemat thickness becomes 10-feet thick at 29 feet from the centerline of the containment and increases to 22-feet at the junction between the shield building wall and the basemat.

SSAR Revision: NONE

Question 220.60

Provide the basis for not considering the wind load in the Level A and C load combinations in which the external pressure is included (Table 3.8.2-1 of Revision 1 to the SSAR).

Response:

As described in SSAR Subsection 3.3.2.4, wind loads on the containment vessel and the air baffle are determined using the results of wind tunnel tests. The test results have been provided in Reference 220.60 - 1. The tests show that the wind causes a reduction in pressure in the annulus between the containment vessel and the shield building. This reduction in pressure would reduce the external pressure on the containment vessel. The governing design condition for external pressure is thus the case without wind loads.

SSAR Revision: None

Reference

220.60 - 1 WCAP 13323-P, Phase II Wind Tunnel Testing for the Westinghouse AP600 Reactor, June, 1992

Question 220.62

Provide descriptions for the polar crane system in Section 3.8.2.1. of the SSAR.

Response:

The polar crane system is described in Subsection 9.1.5.

SSAR Revision:

Revise the next to the last paragraph of Subsection 3.8.2.1.1 as shown below:

The polar crane is designed for handling loads up to 275 tons during normal refueling. The crane girder and wheel assemblies are designed to support a special 400-ton trolley to be installed in the event of steam generator replacement. The polar crane system is described in Subsection 9.1.5.

Question 220.67

For loads and load combinations listed in SSAR Table 3.8.2-1, explain why the operating pressure "P_o" was not included in Load Combinations 6 and 7 (Service Level C) as specified in Equation (iii).(c).(2) in SRP Subsection 3.8.2.II.3.b.

Response:

SSAR Table 3.8.2-1 will be revised as shown below to include the operating pressure in the load combinations 6, safe shutdown earthquake, and 7, Tornado. The range of operating pressure is - 0.2 to + 1.0 psig as given in SSAR Table 3D.5-1.

SSAR Revision: Revise Table 3.8.2-1 as shown on the next page.

Table 3.8.2-1

Load Combinations and Service Limits For Containment Vessel

Load Description		Load combination and service limit									
		Test	Design	A	A	C	C	C	D	A	C
Dead	D	x	x	x	x	x	x	x	x	x	x
Live	L	x	x	x	x	x	x	x	x	x	x
Wind	W			x							
SSE	E_s					x	x		x		
Tornado	W_t							x			
Test pressure	P_t	x									
Test temperature	T_t	x									
Operating pressure	P_o			x			x	x			
Normal reaction	R_o			x			x	x		x	x
Normal thermal	T_o			x			x	x		x	x
Design pressure	P_d		x		x	x			x		
External pressure (2.5 psid)	P_e									x	
External pressure (3.0 psid)	T_o										x
Accident thermal	T_a		x		x	x			x		
Accident thermal reactions	R_a		x		x	x			x		
Accident pipe reactions	Y_r								x		
Jet impingement	Y_j								x		
Pipe impact	Y_m								x		

Notes:

1. Service limit levels are per ASME-NE.

2. Where any load reduces the effects of other loads, that load shall be taken as zero, unless it can be demonstrated that the load is always present or occurs simultaneously with the other loads.

Question 220.79

For the in-containment refueling water storage tank (IRWST), provide in the SSAR, figures and cross sections showing: (a) overall configuration of the tank, (b) the relationship between the tank walls, channel heads, concrete foundation and structural steel modules, and (c) areas covered by the stainless steel or cladding for preventing corrosion.

Response:

SSAR Figure 3A-4 (Sheet 2 of 12) shows the overall configuration of the in-containment refueling water storage tank (IRWST), the relationship between the tank walls, concrete foundation, and structural steel modules. SSAR Figure 3A-4 (Sheet 7 of 12) shows a cross section through the IRWST wall which consists of stiffened plate. The other walls of the IRWST are structural steel modules shown on SSAR Figure 3A-4 (Sheet 6 of 12). The walls, floor, and ceiling of the IRWST exposed to water during normal operation or refueling are fabricated from stainless steel.

SSAR Revision: NONE

Question 220.87

For evaluating the dynamic stability of the NI structures against overturning, provide formulas for calculating the energy component due to embedment effect "W_p" and energy component due to buoyancy "W_b" in Section 3.8.5.5.4 of the SSAR.

Response:

In the dynamic stability evaluation of the NI structures against overturning, the energy component due to embedment effect "Wp" was conservatively neglected and assumed equal to zero. The energy component due to buoyancy "Wb" is determined as follow:

$$W_b = B \times h$$

where: B = buoyant force
h = height to which the center of mass must be lifted to reach the overturning position

SSAR Revision:

Revise the second paragraph of Subsection 3.8.5.5.4 as shown below:

The potential energy is calculated as follows:

$E_o = m_o gh + W_p - W_b$

where:

E_o = potential energy
m_o = total mass of the structure and basemat
g = acceleration due to gravity
h = height to which the center of mass must be lifted to reach the overturning position
W_p = energy component due to the embedment effects
W_b = energy component due to buoyancy

The energy component due to the embedment effects is assumed equal to zero and conservatively neglected. The energy component due to the buoyancy is determined assuming a constant buoyant force (B) throughout the overturning process and is equal to:

$W_b = Bh$

Question 220.88

To prevent the potential of rebar corrosion, evaluate, in the SSAR, the use of coated reinforcing bars for the design of the NI foundation.

Response:

Please see response to RAI No. 220.46.

SSAR Revision:

Add the following paragraph to the end of SSAR Subsection 3.8.4.6.1.2:

As stated in Subsection 3.4.1.1.1, seismic Category I structures which are located below grade elevation are protected against flooding by waterproofing membranes and waterstops. This, in conjunction with the two inches of concrete cover for the reinforcing steel, provides sufficient protection for the reinforcing steel. Therefore, the use of coated reinforcing steel is not planned.

Question 220.90

For the nuclear island structures, provide, in the SSAR, the type and characteristics of water seals to be used at the penetrations (mechanical and electrical) and accesses located below the flood level for preventing and mitigating the external flooding effects.

Response:

SSAR Chapter 2 and Subsection 3.4.1.1.1 establish the maximum flood at less than the finished grade. As stated in the response to RAI 410.38, the AP600 design minimizes the number of penetrations through the walls below grade. Those few penetrations located below the maximum flood level (elevation 100') will be watertight. Any process piping penetrations and electrical conduits through the exterior walls below grade will be embedded in the wall or will be welded to a steel sleeve embedded in the wall. There are no accesses or tunnels penetrating the exterior walls below grade.

SSAR Revision:

Add the following at the end of Subsection 3.4.1.1.1:

Process piping penetrations and electrical conduits through the exterior walls below grade are embedded in the wall or are welded to a steel sleeve embedded in the wall. There are no access openings or tunnels penetrating the exterior walls below grade.

Question 230.50

Seismic analyses for the AP600 design has been conducted since the late 1980s and the assumptions and building configurations have changed during these analyses. Some earlier analyses appear to be used to simplify the number of parametric runs to be considered in the later analyses. Provide a clear auditable trail for the final seismic calculations so that the assumptions made can be fully understood.

Response:

The following analyses were performed in 1990, based on Revision 0 of the General Arrangement Drawings:

- 3D finite element models of the nuclear island structures were developed. The 3D finite element models were used as the bases for the 2D and 3D lumped mass stick models.
- 2D and 3D lumped mass stick models were developed.
- SASSI analyses of the 2D lumped mass stick models were performed for the purpose of establishing the design soil profiles. Three design soil profiles (hard rock, soft rock, and soft-to-medium-soft soil) were established based on the study of multiple soil profiles as described in SSAR Appendix 2A.
- A fixed base analysis of the 3D lumped mass stick models was performed for the hard rock profile using the program BSAP (Mode Superposition Time History Analysis).
- Soil-structure interaction analyses of the 3D lumped mass stick models was performed for the soft rock profile using the program SASSI (Complex Frequency Response Analysis).

In 1992 and 1993, the following analyses were performed based on Revision 3 of the General Arrangement Drawings:

- The 3D finite element models of the nuclear island structures were updated to reflect changes in the structural configuration.
- The 3D lumped mass stick models were updated.
- A fixed base analysis of the updated 3D lumped mass stick models was performed for the hard rock profile using the program BSAP (Mode Superposition Time History Analysis).
- Soil-structure interaction analyses of the updated 3D lumped mass stick models was performed for the soft rock profile using the program SASSI (Complex Frequency Response Analysis).
- Soil-structure interaction analyses of the updated 3D lumped mass stick models was performed for the soft to medium soft soil profile using the program SASSI (Complex Frequency Response Analysis).

- Response spectrum analyses of the 3D finite element models to obtain the in-plane forces to be used for the design of the floors and walls was performed using the program BSAP. This was done only for the fixed base hard rock profile.

- Floor response spectra for all three design soil profiles were developed, enveloped, and broadened.

The 1992 and 1993 analyses are the bases for SSAR, Revision 1. It is noted that the General Arrangement Drawings shown currently in Section 1.2 of the SSAR are based on Revision 5. The general arrangement revisions will be reconciled as follows:

- The 3D finite element models of the nuclear island structures will be updated.

- Response spectrum analyses of the fixed base 3D finite element models will be performed for the hard rock profile using the program BSAP. The resulting frequencies, modal effective mass, and response accelerations will be compared to the previous results to verify that the current models are still valid.

Results of this reconciliation will be submitted in March, 1995.

SSAR Revision: NONE

Question 230.53

According to the SSAR, only three soil conditions (shear wave velocity equal to 1000 ft/sec, 2500 ft/sec and 8000 ft/sec) were used in the seismic design of AP600 standard plant. Provide justification for not including the site conditions with other shear wave velocities, such as 1500 ft/sec and 3500 ft/sec and different depths from grade to bedrock.

Response:

The subject of this RAI was discussed during a meeting among NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared foll wing the May meeting.

SSAR Revision: NONE

Question 230.55

Justify the adequacy of using the SASSI computer code to calculate member forces for the structural design. According to the staff's experience and understanding, the SASSI analyses will produce inaccurate member forces.

Response:

The member forces calculated by SASSI for the AP600 analyses are accurate. Tables 3.7.2-11, 3.7.2-12 and 3.7.2-13 present the maximum member forces and moments for the three site conditions. The results for the soft rock and soft-to-medium soil conditions are calculated using SASSI. The member forces were verified by comparison against member forces calculated using the SASSI acceleration responses at each of the mass points.

SSAR Revision: NONE

AP600

Question 230.62

Justify the validity of performing a fixed-base seismic analysis for the site conditions with shear wave velocity equal to or greater than 8000 ft/sec.

Response:

The subject of this RAI was discussed during a meeting among NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared following the May meeting.

SSAR Revision: NONE

AP600

Question 230.69

Include the shallow soil site conditions in the SSAR and in the seismic analysis of nuclear island structures. In addition, for these site conditions, the guidance in Section 3.7.1 of the SRP for specifying control motion should be followed.

Response:

The subject of this RAI was discussed during a meeting among NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared following the May meeting.

SSAR Revision: NONE

Question 230.70

Document, in the SSAR, the procedures for developing seismic response envelopes (e.g., floor response spectra).

Response:

The enveloped response results shown in parenthesis in Tables 3.7.2-5 through 3.7.2-10 is the maximum value of the response at any of the referenced edge nodes (north, south, east and west edge nodes).

The envelopes of the floor response spectra for the three design soil profiles were developed as follows:

- The spectral acceleration was calculated at the same frequencies for all three of the design soil profiles
- The maximum spectral acceleration at each frequency from any of the three design soil profiles was then selected for the envelope
- The enveloped floor response spectra is then broadened by ±15%.

SSAR Revision:

Revise the note at the bottom of Tables 3.7.2-5 through 3.7.2-10 as follows:

Note: Enveloped response results at the north, south, east and west edge nodes of the structure are shown in parentheses. This is the maximum value of the response at any of these edge nodes.

Revise the third paragraph of Subsection 3.7.2.5 as follows:

The floor response spectra for the design of subsystems and components are generated by enveloping the nodal response spectra determined for the different design soil profiles. The envelopes of the floor response spectra for the three design soil profiles are developed as follows:

- The spectral acceleration is calculated at the same frequencies for all three of the design soil profiles
- The maximum spectral acceleration at each frequency from any of the three design soil profiles is then selected for the envelope
- The enveloped floor response spectra is then broadened by ±15%.

Question 230.79

From the review of Figures 3.7.1-14 and 3.7.1-15 of the SSAR, it appears that the soil shear degradation curves for the typical soil used in the analysis and design are based on the soil shear degradation model recommended by H.B. Seed and I.M. Idriss in 1970. A comparison of the shear degradation curves presented in Figures 3.7.1-14 and 3.7.1-15 in the SSAP, with the current published industry results, such as the results published by I.M. Idriss and Geomatrix in 1990, shows that the Seed-Idriss 1970 curves overestimated the soil strain degradation. The staff anticipates that the use of the Seed-Idriss 1970 curves in the SSI analyses of the NI structures will underestimate the seismic structural responses. Provide the basis for using the Seed-Idriss 1970 curves in the SSI analyses.

Response:

The subject of this RAI was discussed during a meeting among NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared following the May meeting.

SSAR Revision: NONE

Question 230.80

Subsection 3.7.2.1 of the SSAR (pg. 3.7.2-3) indicates that separate seismic analyses are performed for the nuclear island (NI) for each of the soil profiles defined in Section 3.7.1.4 and the three sets of in-structure seismic responses are enveloped to obtain the seismic design envelope (design member forces, nodal accelerations, nodal displacements, and floor response spectra) used in the design and analysis of seismic Category I structures, components, and seismic subsystems. The staff is concerned that the seismic design of the structures, systems and components of the AP600 standard plant may not be sufficient because it considers only three generic site conditions characterized with soil shear wave velocities that are far apart from each other. An example of the staff's concern is shown in the floor response spectra (FRS) plots of Figure 3.7.2-25. As shown in these plots, the horizontal (EW component in particular) FRS envelope in the control room area may not cover the FRS from two possible intermediate site conditions, one with a shear wave velocity between 1000 ft/sec and 2400 ft/sec (approximately 1500 ft/sec) and the other with a shear wave velocity between 2400 ft/sec and 8000 ft/sec (approximately 3500 ft/sec). Justify the adequacy of using only three generic site conditions for the AP600 standard plant design.

Response:

The subject of this RAI was discussed during a meeting among NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared following the May meeting.

SSAR Revision: NONE

Question 230.81

Sections 3.7.2.1.1 and 3.7.2.1.2 of the SSAR state that the computer code "SAP" was used for performing seismic analyses (response spectrum analysis and time-history analysis) of seismic Category I structures and Reference 7 is used. However, the computer code "BSAP" is referenced in Reference 7. Clarify this inconsistency.

Response:

The computer program referenced as SAP in Subsections 3.7.2.1.1 and 3.7.2.1.2 of the SSAR is actually BSAP.

SSAR Revision:

Revise the first paragraph of Subsection 3.7.2.1.1 as shown below:

Response spectrum analyses, using computer program BSAP (Reference 7), are performed to obtain the seismic forces and moments required for the structural design of the auxiliary building, the shield building, and the containment internal structures on the nuclear island.

Revise the first paragraph of Subsection 3.7.2.1.2 as shown below:

Mode superposition time-history analyses using computer program BSAP and complex frequency response analysis using computer program SASSI (Reference 8) are performed to obtain the in-structure seismic response (accelerations, displacements, and floor response spectra) needed in the analysis and design of seismic subsystems.

Revise the third paragraph of Subsection 3.7.2.1.2 as shown below:

For the hard rock site where the shear wave velocity is in excess of 8000 feet per second, the soil-structure interaction effect is negligible. Therefore, for the hard rock site, the nuclear island is analyzed as a fixed-base structure, using computer program BSAP without the foundation media. The three components of earthquake (two horizontal and one vertical time histories) are applied simultaneously in the analysis.

Question 230.84

In Section 3.7.2.1.1 of the SSAR, provide information and explanation to demonstrate:

a. that for site conditions with soil shear wave velocity equal or greater than 8000 ft/sec, the SSI effects between NI structures and soil foundation are negligible and the use of fixed base models is adequate for calculating seismic responses of the NI structures, and

b. that for structures with multimodes, the amplification procedures, described for cases where the responses of soil founded structures exceed the responses of rock (shear wave velocity equal or greater than 8000 ft/sec) founded structures, will provide reasonable results for the design of structures, systems and components.

Response:

The subject of this RAI was discussed during a meeting among NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared following the May meeting.

SSAR Revision: NONE

AP600

Question 231.15

What are the geography and demography limits for a site at which an AP600 plant could be located?

Response:

The geography and demography are site specific and will be defined by the Combined License applicant. There are no preestablished geography and demography limits for a site at which a plant could be located. The site interface parameters for the AP600 are outlined in SSAR Chapter 2

SSAR Revision: NONE

Question 231.16

Indicate, in the SSAR, what specific design features of the AP600 standard plant allow for a flood level up to the plant grade elevation.

Response:

As stated in Subsection 3.4.1.1.1 of the SSAR, seismic Category I structures which are located below grade elevation are protected against flooding by waterproofing membranes and waterstops. Subsection 3.4.1.2.1 of the SSAR describes the structural and stability considerations associated with the probable maximum flood and high ground water table. Also please see response to RAI 220.90.

SSAR Revision: NONE

Question 231.22

In the January 22, 1993 response to Q231.5 regarding the assumption of an upper bound value of 8000 feet per second (fps) for the shear wave velocity of the hard rock site, Westinghouse states that, for the hard rock site profile with shear wave velocity of 8000 fps (greater than 3500 fps), the nuclear island is analyzed as a fixed base structure. However, the decision to use fixed base analyses should not be based on a specified rock shear wave velocity, but on the relationship between the SSI frequency and the structural frequency of the NI.

Perform necessary SSI studies for the rock model (with rock shear wave velocity ranging from 8000 to 11000 fps discussed in Q231.5 to justify the use of fixed base analysis for the rock site with shear wave velocity of 8000 fps.

Response:

The subject of this RAI was discussed during a meeting amoung NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared following the May meeting.

SSAR Revision: NONE

Question 231.30

No specific evaluations have been made on the potential impact of non-vertically incident ground motion on the NI responses. On this basis,

a. perform SASSI analyses to study the significance of such motions, and report the results in the SSAR, and

b. consider the impact of using different P and S wave hysteretic damping of site soils using the SASSI analysis.

Response:

The subject of this RAI was discussed during a meeting among NRC staff and consultants and Westinghouse and Bechtel on seismic analyses on April 14, 1994 and will be discussed further during a meeting scheduled at the end of May. A written response to this RAI will be prepared following the [illegible] meeting.

SSAR Revision: NONE

Question 231.31

For sites where the soil characteristics are outside the range considered in Appendix 2A.2 of the SSAR, why are the comparisons of the site specific soil-structure interaction analysis results to the design floor response spectra made at only a very limited number of locations?

Response:

As stated in Subsection 2.5 of the SSAR, comparison of the floor response spectra at the following locations is sufficient demonstration that the site seismic conditions are within the AP600 design basis:

- Reactor vessel support (Elevation 98')
- Containment operating floor (Elevation 135.25')
- Shield building roof (Elevation 307.25')
- Control room floor (Elevation 117.5')

The four locations are judged to be sufficient for the following reasons:

- They cover the entire nuclear island from grade (reactor vessel support) to the top (shield building roof).
- They cover the containment internal structures where the major equipment is located or supported (reactor vessel support to the containment operating floor).
- They cover the coupled shield and auxiliary buildings from grade to the top of the shield building, including the control room.

SSAR Revision: NONE