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Energy Systems

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NTD-NRC-94-4259
DCP/NRC0184
Docket No.: STN-52-003

August 10, 1994

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 May 5, 1994, May 12, 1994, and May 26, 1994. In addition, revisions of responses previously submitted are provided. This completes the responses for letters dated May 5, 1994, May 12, 1994 and May 26, 1994.

A listing of the NRC requests for additional information responded to in this letter is contained in Attachment A. Attachment B is a complete listing of the questions associated with your letters of April 19, 1994, April 28, 1994, April 29, 1994, May 5, 1994, May 12, 1994 and May 26, 1994.

A copy of the response to RAI 440.118 is provided in the enclosure. Some copies of letter NTD-NRC-94-4234, dated July 22, 1994 did not include this response. A copy of the response to RAI 230.63 Revision 2 is provided in the enclosure. The copy in the original transmittal was not marked as Revision 2.

These responses are also provided as electronic files in WordPerfect 5.1 format with Mr. Kenyon's copy. The file for RAI 230.63 Revision 2 is included.

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

Nicholas J. Liparulo

Nicholas J. Liparulo, Manager
Nuclear Safety Regulatory And Licensing Activities

/nja

Enclosure

cc: B. A. McIntyre - Westinghouse
T. Kenyon - NRR

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NTD-NRC-94-4259
ATTACHMENT A
AP600 RAI RESPONSES
SUBMITTED AUGUST 10, 1994

RAI No.	Issue
230.029R01	Basis for damping ratio
230.063R02	Soil column properties for horiz. & vert. models
231.030R01	Impact of non-vertically incident ground motion
440.014R01	ADS testing
440.145	WCOBRA/TRAC
440.148	WCOBRA/TRAC
440.154	WCOBRA/TRAC
440.155	WCOBRA/TRAC
460.018	COL action items for waste management
480.056R01	Relief valves as containment isolation barriers
952.065	ADS phase B, measurement of liguid flow rate
952.079	SPES-2 initial uppper head temperature

ATTACHMENT B

CROSS REFERENCE OF WESTINGHOUSE RAI RESPONSE TRANSMITTALS TO NRC LETTERS OF APRIL 19, 1994, APRIL 28, 1994, APRIL 29, 1994, MAY 5, 1994, MAY 12, 1994, MAY 26,1994,

Question No.	Issue	NRC Letter	Westinghouse Transmittal Date
440.073	Control Rod Position Monitoring System	04/19/94	08/03/94
440.074	ASME overpressure protection report	04/29/94	08/03/94
440.075	Sizing of pressurizer safety valves	04/29/94	06/27/94
440.076	Effects of water relief on pressurizer safety vlvs	04/29/94	06/30/94
440.077	Environmental conditions for PZR safety valves	04/29/94	06/27/94
440.078	LTOP analysis	04/29/94	07/29/94
440.079	Tests for NRHRS relief valves	04/29/94	07/15/94
440.080	Operator actions for low temperature operation	04/29/94	08/03/94
440.081	TS LCO 3.4.13, LTOP system	04/29/94	06/30/94
440.082	TS LCO 3.4.13, increasing RCS temperature	04/29/94	06/27/94
440.083	Required MSSV relief capacity	04/29/94	08/03/94
440.084	Quality group classification for LTOP system	04/29/94	06/27/94
440.145	WCOBRA/TRAC	05/05/94	08/10/94
440.146	WCOBRA/TRAC	05/05/94	08/08/94
440.147	WCOBRA/TRAC	05/05/94	08/08/94
440.148	WCOBRA/TRAC	05/05/94	08/10/94
440.149	WCOBRA/TRAC	05/05/94	08/08/94
440.150	WCOBRA/TRAC	05/05/94	08/08/94
440.151	WCOBRA/TRAC	05/05/94	08/08/94
440.152	WCOBRA/TRAC	05/05/94	08/08/94
440.153	WCOBRA/TRAC	05/05/94	08/08/94
440.154	WCOBRA/TRAC	05/05/94	08/10/94
440.155	WCOBRA/TRAC	05/05/94	08/10/94
440.156	WCOBRA/TRAC	05/05/94	08/08/94
440.167	Main steamline break analysis assumptions	05/26/94	08/03/94
440.168	Shutdown operations	05/26/94	08/03/94
460.017	Applicability of IE Bulletin 80-65	05/12/94	06/30/94
460.018	COL action items for waste management	05/12/94	08/10/94
460.019	Incorporation of RAI responses in SSAR	05/12/94	06/27/94
460.020	Radwaste systems compliance with RG 1.143	05/12/94	08/03/94
460.021	Compliance with 10 CFR Part 20 limits	05/12/94	08/03/94
460.022	Waste gas processing system failure analysis	05/12/94	08/03/94
460.023	Cont. filtration system compliance with RG 1.140	05/12/94	06/27/94
460.024	Dilution flow for liquid waste discharge	05/12/94	06/30/94
460.025	GALE code calculations with revised inputs	05/12/94	08/03/94
460.026	Addition of N-16 activity to SSAR Table 11.1-8	05/12/94	06/30/94
490.001	Similarity to 17x17 VANTAGE-5H	04/19/94	06/30/94
490.002	Use of option in fuel management	04/19/94	06/30/94
490.003	Approval of calculational procedures	04/19/94	06/30/94
490.004	Use of emperical data	04/19/94	06/27/94
490.005	VANTAGE-5H vibration problems	04/19/94	06/30/94
490.006	Comparison of nozzle ETC with previous design	04/19/94	06/27/94
490.007	Fuel performance evaluation control	04/19/94	06/27/94
490.008	Rod bow model	04/19/94	06/27/94
490.009	Definition of material corrosion rates	04/19/94	06/27/94
490.010	Justification for no waterlogging	04/19/94	06/27/94
491.001	Reactivity coefficients	04/19/94	06/27/94
491.002	Compliance conditions	04/19/94	06/27/94
491.003	Shutdown margin uncertainties	04/19/94	06/27/94
491.004	Skewed flux distribution	04/19/94	06/27/94
491.005	Rod insertion limit calculation	04/19/94	06/27/94
491.006	Boron calculation	04/19/94	06/27/94
491.007	Gray rods	04/19/94	06/30/94
492.001	Thermal design procedure parameters	04/19/94	06/27/94
492.002	Bypass flow	04/19/94	06/30/94
492.003	Rod bow penalty	04/19/94	06/27/94
492.004	W-3 DNB correlation	04/19/94	06/27/94
492.005	Fixed incore detector monitor	04/19/94	07/25/94
720.272	Shutdown PRA - Maintenance Unavailability	04/28/94	07/27/94
720.273	Shutdown PRA - Loss of NRHR initiator	04/28/94	07/27/94
720.274	Shutdown PRA - Overdraining of Reactor Vessel	04/28/94	07/27/94
720.275	Shutdown PRA-Operator diversion of vessel inventor	04/28/94	07/22/94
920.003	Security lighting	04/19/94	08/03/94

Question No.	Issue	NRC Letter	Westinghouse Transmittal Date
920.004	SRP compliance reference	04/19/94	05/19/94
952.065	ADS phase B, measurement of liguid flow rate	05/26/94	08/10/94
952.066	SPES-2 test facility break location details	05/26/94	07/22/94
952.067	SPES-2 break location, size & geometry	05/26/94	07/22/94
952.068	Basis for SPES-2 setpoints	05/26/94	07/22/94
952.069	SPES-2 pressurizer heater power	05/26/94	07/22/94
952.070	SPES-2 CMT level setpoint	05/26/94	07/22/94
952.071	SPES-2 PRHR operation	05/26/94	07/22/94
952.072	SPES-2 hot & cold shakedown data	05/26/94	07/22/94
952.073	SPES-2 pump coastdown data	05/26/94	07/22/94
952.074	SPES-2 leakage power	05/26/94	06/30/94
952.075	SPES-2 SG recirculation ratios	05/26/94	08/08/94
952.076	SPES-2 ADS stage 4 L/d values	05/26/94	07/22/94
952.077	SPES-2 CMT outer tank temp. & pressure	05/26/94	07/22/94
952.078	SPES-2 lower plenum conditions	05/26/94	06/27/94
952.079	SPES-2 initial uppper head temperature	05/26/94	08/10/94
952.080	SPES-2 orifice sizes, locations & flows	05/26/94	07/22/94
952.081	SPES-2 facility drawings	05/26/94	07/22/94
952.082	SPES-2 pipe schedule changes	05/26/94	07/25/94
952.083	SPES-2 piping system bend/elbow radii	05/26/94	06/27/94
952.084	SPES-2 valve type & sizes	05/26/94	07/22/94
952.085	SPES-2 pressure vessel connections	05/26/94	06/27/94
952.086	SPES-2 insulation characteristics	05/26/94	07/22/94
952.087	SPES-2 upper plenum & annular downcomer	05/26/94	06/27/94
952.088	SPES-2 pressurizer	05/26/94	07/22/94

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Question 230.29

On Page 3.7-2 and in Table 3.7-1 of the SSAR, the damping ratios assigned for HVAC ductwork, cable trays and fuel assemblies are 7%, 20% and 20%, respectively. Provide the bases for these parameters to justify the adequacy of using high damping ratios for the analyses of the welded ductworks, cable trays and fuel assemblies.

Response: (Revision 1)

HVAC Ductwork:

Typically, the AP600 ductwork are bolted with gasketed flange construction. The damping value used for heating, ventilation, and air conditioning (HVAC) systems, including ducts and the related supports, is equal to 7 percent of critical damping in conformance with guidance for bolted structures in Regulatory Guide 1.61. For special conditions where welded ductwork are used, the damping values used is equal to 4 percent of critical damping in conformance with guidance for welded structures.

Cable Trays:

The damping value used for electrical raceways systems, including cable trays and the related supports, is established based on the Bechtel/ANCO test results (Reference 19 of SSAR Section 3.7 Revision 1) for a variety of raceway configurations. The damping value depends on the magnitude of the input motion and the amount of cable fill within the cable tray as shown in SSAR Figure 3.7.1-13. Within the AP600 design range of acceleration, the damping value is equal to 7 percent for empty cable trays and up to 20 percent for greater than 50 percent filled cable trays.

Fuel assemblies:

The fuel assembly damping values are based on measured values from mechanical tests in both air and water environments. The fuel assembly damping value increases as vibrational amplitude increases. The fuel assembly damping under flowing water conditions exhibit very high values. Plant in-core neutron detector data indicate that a PWR fuel assembly is a highly damped structural system. The assembly damping is a result of combined inter-assembly rubbing and scraping, frictional forces and constraint of relative motion between the fuel rods and supports within an assembly, and fluid/structure interactions in a closely packed reactor core.

In analyses of a safe shutdown earthquake or of a LOCA transient, a fuel assembly is usually predicted to deflect to the physical limit of accumulated inter-fuel assembly gaps. To assess the fuel assembly dynamic responses under a postulated faulted condition transient, a 20 percent damping value is used to account for the mechanical and hydrodynamic effects for the assembly fundamental mode. This 20 percent fuel assembly damping value used in the analysis is conservative relative to the data from in-core neutron detectors. The fundamental mode of a fuel assembly is identified as the predominant mode for fuel dynamic analysis. Thus, the 20 percent damping ratio is applied to all fuel assembly vibrational modes.

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: (Revision 1)

a. The Standard Review Plan does not require the consideration of non-vertically incident ground motion. Such waves generally have only small influence on the plant responses and are adequately considered by the overall conservatism of the seismic design process. Therefore, such waves are not specifically considered in the AP600 design.

b. See response to RAI 230.63.

~~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 440.14

The detailed design ("layout") for the ADS Phase B valve tests is not specified in Revision 0 to WCAP-13342. This information should be provided in the updated test specification requested in Q440.11. In addition, the relationship of the test layout to the actual configuration of ADS stages 1-3 in the plant design should be discussed. If the test facility design does not replicate the piping configuration between the ADS valves and the sparger, the deviations in the facility design from the plant design should be completely documented, and the impact of such deviations on application of the data to analysis of plant performance should be discussed.

Response (Revision 1):

~~The updated revision of WCAP-13342 (see Q440.11) will include a detailed layout of the ADS Stages 1, 2 and 3 piping. This layout will be identical to the currently specified AP600 ADS layout above the pressurizer. Piping layout deviations between the ADS valve package and the sparger will be documented and discussed.~~

Revision 1 of WCAP-13342 (see Q440.11) includes a description of the Phase B ADS Stages 1, 2 and 3 piping layout. This layout is prototypical of the AP600 ADS layout above the pressurizer. Piping layout deviations between the test and the plant configuration will be discussed in the ADS Phase B Facility Description Report which will be provided to the NRC in March, 1995.

SSAR Revision: NONE

Question 440.145

Section 28-2 of the Code Qualification Document (CQD) for WCOBRA/TRAC, "Compliance with Regulatory Guide 1.157, REGULATORY POSITION 1," states that application of WCOBRA/TRAC to the AP600 design is considered acceptable, based on information in the CQD and confirmatory tests and comparisons currently being performed on the unique features of the AP600 design, the results of which will be provided in other reports. Describe the specific features of the AP600 design that will be evaluated with these tests, and show how the results will be used to meet the requirements of the Regulatory Position. Are the results to be incorporated into a later edition of the CQD?

Response:

A Code Applicability document will be submitted by September 30, 1994 which will describe the application of the WCOBRA/TRAC code to the AP600. This document will contain data comparisons to experiments which model AP600 features. These results will supplement the data comparisons for the code provided in the WCOBRA/TRAC code qualification document (CQD).

SSAR Revision: None
PRA Revision: None

Question 440.148

a. The upper plenum crossflow de-entrainment model is based on the results from Dallman and Kirchner[*] which uses an air-water mixture as a simulant for steam-water. The range of validity is based on conditions existing during reflood and is stated as a maximum of 4 bars pressure else Re_G and We_G become atypically high. It is not shown to be applicable during the automatic depressurization sequence, which begins at a much higher pressure (~1100 psi, or about 75 bars). Justify the models intended for use in the prediction of interphasic drag and liquid entrainment/deentrainment.

b. It is also important to calculate the correct liquid deentrainment or phasic separation at the surge line nozzle. Explain how you will represent this phenomena in the Best Estimate LOCA Methodology.

Response:

The response to this question will be included in the responses to the generic WCOBRA/TRAC review questions. A revision to this RAI, which responds to the specific questions of this RAI, will be provided following submittal of the responses to the generic WCOBRA/TRAC questions in September 1994.

SSAR Revision: None
PRA Revision: None

[*] J. C. Dallman and W. L. Kirchner, *De-Entrainment Phenomena on Vertical Tubes in Droplet Cross Flow*, NUREG/CR-1421, LA-8316-MS, April 1980.

Question 440.154

If extended core boiloff occurs, boric acid will accumulate and precipitate, thus interfering with the ability to maintain core cooling. There is, therefore, a need to demonstrate subcooled liquid throughput during the long term portion of the transient that will maintain boric acid concentration within acceptable limits. Describe the methodology that will be used, and how it will be used, to evaluate this issue, including applicable data assessments.

Response:

The long term cooling transients will be simulated in the Oregon State University Tests which will examine the boil-off and core subcooling phenomena characteristic of the long term cooling events. The WCOBRA/TRAC model will be validated against the OSU tests and will be used to confirm liquid flow through the core in the long term cooling mode. The WCOBRA/TRAC V&V report will be submitted in May 1995. Based upon this liquid flow, it will be shown that the design maintains boric acid concentrations within acceptable limits. The calculations will be available for NRC review in May 1995.

SSAR Revision: None
PRA Revision: None

Question 440.155

An integral part of the AP600 design is the passive containment cooling system (PCCS). Westinghouse does not appear to be using a containment model in WCOBRA/TRAC. Identify and justify the methodology to be used to predict the performance of the PCCS and its role in the long term coolability of the core, including comparisons to applicable assessment data, and how the methodology is to be incorporated into the AP600 evaluation.

Response:

There are two aspects of the containment which are accounted for in the LOCA model; condensate return and containment backpressure.

WGOTHIC computes the containment conditions during long term cooling, including condensate delivery to the sumps and/or IRWST. Boundary conditions derived from the WGOTHIC calculations will be input to the WCOBRA/TRAC long term cooling (LTC) model. WCOBRA/TRAC LTC will model the reactor coolant system, IRWST, and sump and will predict the long term cooling performance of the reactor coolant system. The AP600 response to different containment boundary condition scenarios as defined by the WGOTHIC code predictions of PCCS performance will be used to examine the containment effects on core long term cooling behavior.

The WGOTHIC code has been compared to the large scale containment tests to verify the containment models. The WCOBRA/TRAC LTC model will be compared to the Oregon State University tests which include the IRWST and sump injections and also simulate the condensate return to the IRWST and sump.

The effects of the AP600 containment back pressure are not modeled for the large-break LOCA transient. There have been sufficient sensitivity studies performed on Westinghouse plants that show that use of a conservatively low containment back pressure results in higher calculated peak cladding temperatures in the core. The SSAR large-break LOCA calculations were performed assuming atmospheric containment back pressure for additional conservatism. If calculations were performed using a higher containment back-pressure from the WGOTHIC analysis, the resulting limiting break peak cladding temperature would be lower then the values reported. Because of this conservatism, the containment back-pressure is decoupled from the systems analysis for the large-break LOCA.

A similar approach of using atmospheric containment pressure will be used for the long term cooling portions of the transients. There have been tests performed, as well as small break analysis (Reference 440.155-1), which show that the assumption of atmospheric containment pressure is conservative. This conservative methodology permits the decoupling of the containment calculation from the systems calculation.

Reference:

440.155 Westinghouse letter NTD-NRC-94-4239, "AP600 LOCA Analysis Sensitivity to Containment Pressure," dated 7/29/94

SSAR Revision: None
PRA Revision: None

Question 460.18

Because specific compliance with Appendix I of 10 CFR Part 50 for gaseous and liquid effluents (which includes offsite dose guidelines and cost-benefit analysis criterion), and the guidelines given in ANSI N13.1 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities," Regulatory Guide (RG) 1.21 "Measuring and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," and RG 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operation) - Effluent Streams and the Environment," is not within the scope of the AP600 design, the staff will review individual COL applications referencing the AP600 design to ensure their conformance with these documents. Section 1.8 of the SSAR summarizes the COL and site dependent interfaces, but these are not complete. Besides the above, the setpoints for terminating instantaneous discharges of liquid waste and processed waste gas [which will be given in site-specific offsite dose calculation manual (ODCM)] will be reviewed on a site-specific basis. Also, conformance with 10 CFR Parts 61 and 71 for processed solid wastes will be reviewed on a site-specific basis. The COL applicant may be required to prepare an operation and maintenance manual to demonstrate compliance with Section 50.34(f)(2)(xvii) of 10 CFR Part 50 as it relates to noble gas effluent monitoring and sampling and analyzing plant gaseous effluents for radioiodine and particulates during and following an accident (the above regulation incorporates the guidelines of TMI Action Item II.F.1, Attachments 1 and 2). Also, the staff will review the COL applicant's Process Control Program (PCP) for processing "wet" solid wastes. The staff will also review quality assurance (QA) provisions for liquid, gaseous and solid waste management systems against RG 1.143 guidelines.

Therefore, the staff believes that all the following items should be identified as COL Action Items in Sections 11.2 through 11.5 of the SSAR:

<u>Section 11.2 (Liquid Waste Management System)</u>

The COL applicant should provide:

a. A statement of specific compliance with Appendix I numerical objectives for offsite individual doses via liquid effluents and cost-benefit analysis for population doses via liquid effluents.

b. The basis for set point calculation in the plant-specific ODCM for terminating liquid waste discharge:

$$\sum_{i} \frac{C}{C_{\text{i liquid effluent limit for isotope i in any unrestricted area}}} \leq 10$$

For the C_{eff} limit, see 10 CFR Part 20, Sections 20.1001-20.2402, Appendix B, Table 2, Column 2.

c. A statement of compliance with the QA provisions of RG 1.143.

Section 11.3 (Gaseous Waste Management System)

The COL applicant should provide:

a. A statement of specific compliance with Appendix I numerical objectives for offsite individual doses via gaseous effluents and cost-benefit analysis for population doses via gaseous effluents.

b. The basis for set point calculation in the plant-specific ODCM for terminating instantaneous GWPS discharge: This should be based on instantaneous dose rates in unrestricted areas due to radioactive materials released via gaseous effluents. The following are the limits: noble gases 500 mrem/yr total body; 3000 mrem/yr skin; others 1500 mrem/yr to any organ. Note: Instantaneous rate here means the above annual dose rates prorated for 1 hour.

c. A statement of compliance with the QA provisions of RG 1.143

Section 11.4 (Solid Waste Management System)

The COL applicant should provide:

a. A demonstration that the wet waste processing will result in products that comply with 10 CFR 61.56

b. The establishment and implementation of a PCP for processing wet solid wastes, i.e., solidifying (if applicable) using an approved solidification agent and the dewatering processing of spent resins.

c. A discussion of on-site storage of low-level waste and demonstration that such a facility will meet GL 81-38 guidelines (only if applicable).

d. A demonstration that all radioactive waste shipping packages will meet 10 CFR Part 71.

e. A statement of compliance with the QA provisions of RG 1.143.

Section 11.5 (Process and Effluent Monitoring and Sampling Systems

The COL applicant should provide:

a. Sampling details and demonstration of compliance with RGs 1.21 and 4.15, and ANSI N13.1 guidelines.

b. An operation and maintenance manual to demonstrate compliance with 10 CFR Part 50, Section 50.34(f)(2)(xvii) with regard to monitoring and sampling of gaseous effluents during and following an accident.

Response:

Chapter 2 of the SSAR defines the site-related parameters for which the AP600 plant is designed. These parameters envelope most potential sites in the United States. This chapter discusses how the specific interfaces are to be used in the AP600 design. The Combined License applicant is responsible to demonstrate that the selected site meets the interface.

For cases where a site characteristic exceeds the envelope parameter, it is the responsibility of the Combined License applicant referencing the AP600 to demonstrate that the site characteristic does not exceed the capability of the design. Thus, it is not necessary or appropriate to include in the design certification of the AP600, requirements and commitments for applicants with sites that do not meet the site characteristics for the standard design. Where the plant design must accommodate site specific issues, these are referenced in the SSAR.

Regarding the specific items which were requested to be assigned for COL action, for each radwaste system, the information is addressed as follows:

Liquid Radwaste System

a. The AP600 compliance with 10 CFR 50, Appendix I is discussed in SSAR section 11.2.3.1. The cost-benefit analysis for population doses via plant effluents after severe accidents is discussed in SSAR Appendix 1B. This appendix shows that the radwaste processing systems are sufficiently effective in controlling radioactive releases such that there is no additional cost-benefit to be gained by adding capital cost to the radwaste processing systems.

b. Radiation monitor setpoints which terminate liquid waste discharge are based on limits as defined in 10 CFR 50, Appendix I as discussed in SSAR section 11.2.3.1.

c. Please refer to the response to RAI 460.20, part C.6 for a discussion of compliance to the QA provisions of Regulatory Guide 1.143.

Gaseous Radwaste System

a. The AP600 compliance with 10 CFR 50, Appendix I is discussed in SSAR section 11.3.3.4. The cost-benefit analysis for population doses via plant effluents after severe accidents is discussed in SSAR Appendix 1B. This appendix shows that the radwaste processing systems are sufficiently effective in controlling radioactive releases such that there is no additional cost-benefit to be gained by adding capital cost to the radwaste processing systems.

b. Gaseous radiation monitor setpoints which terminate gaseous waste discharge are based on limits as defined in 10 CFR 50, Appendix I as discussed in SSAR section 11.3.3.4.

c. Please refer to the response to RAI 460.20, part C.6 for a discussion of compliance to the QA provisions of Regulatory Guide 1.143.

Solid Waste Management System

a. SSAR section 11.4.1.3 discusses compliance with 10CFR61 and site specific disposal requirements.

b. Processing of wet solid wastes is discussed in SSAR sections 11.4.2.3.1 and 11.4.2.4.1. The method uses an approved solidification agent and a carbon steel liner for shipping and disposal. See the response to RAI 460.11, Revision 1 for additional detail.

c. Please refer to the response to RAI 460.5, Revision 1 for a demonstration of the storage facilities for solid radwaste.

d. SSAR section 11.4.1.3 requires compliance with 10CFR71 for packaging of radioactive solid wastes.

e. Please refer to the response to RAI 460.20, part C.6 for a discussion of compliance to the QA provisions of Regulatory Guide 1.143.

Process and Effluent Monitoring and Sampling Systems

a. Compliance with Regulatory Guide 1.21 is discussed in SSAR sections 11.5.1.2 and 11.5.2.3.3. The radiation monitoring system is supplied and maintained according to a quality assurance program per the requirements of ASME NQA-1-1989 Edition through NQA-1b-1991 Addenda, as outlined in Chapter 17 of the SSAR. This quality program meets the requirements of Reg. Guide 4.15 "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment". The radiation monitoring system is also specified to be in compliance with ANSI N13.1 "Guide to Sampling Airborne Radioactive Materials".

b. As stated in SSAR sections 9.3.3.1.2.2, 11.5.2.3.1 and 11.5.2.3.3, the monitoring and sampling of effluents will be performed according to Reg. Guide 1.97. The 10CFR50 monitoring requirements are reflected in Reg. Guide 1.97.

SSAR Revision:

Revise section 11.5:

11.5 RADIATION MONITORING

The radiation monitoring system (RMS) is designed to provide plant effluent monitoring, process fluid monitoring, and continuous indication of the radiation environment ~~flux~~ in plant areas where such information is needed. Radiation monitors that have a nuclear safety-related function, and also certain radiation monitors designated in the Regulatory Guides, are qualified environmentally and seismically. Class 1E radiation monitors conform to the separation criteria described in Subsection 8.3.2 and to the fire protection criteria described in Subsection 9.5.1.

The radiation monitoring system is installed permanently and operates in conjunction with the regular and special radiation survey programs performed by the Combined License holder to assist in meeting applicable regulatory requirements. The radiation monitoring system shall be designed in accordance with ANSI N13.1 and operated with a quality program in compliance with Regulatory Guide 4.15.

The radiation monitoring system is divided functionally into two subsystems:

- Process and effluent radiological monitoring and sampling
- [illegible] monitoring.

Question 480.56

An SRP criterion for use of relief valves as containment isolation barriers is that the setpoint be ≥ 150 ~~105~~ percent of the containment design pressure. Confirm that the relief valves of Table 3.2-1 of the SSAR meet this criterion. Will these valves open under severe accident (Service Level C) conditions?

Note: Revision 1 provided in response to a correction of the NRC question.

Response: (Revision 1)

The following relief valves are identified as containment boundaries in SSAR Table 6.2.3-1:

CVS	Penetration P05	Valve V056
CVS	Penetration P06	Valve V042
RNS	Penetration P19	Valve V021
SGS	Penetration P23/P24	Valves V030A,B; V031A,B; V032A,B

The relief valve set pressures for each of the above valves will be in excess of both 150% ~~105%~~ of containment pressure and a containment pressure relating to ASME Service Level C stress limits. The valves will therefore not open under design basis accident conditions or severe accident design conditions.

SSAR Revision:

6.2.3.1.3 Additional Requirements

M. Relief valves that serves as a part of the containment boundary have a set pressure in excess of the 150 ~~105~~ percent of containment design pressure.

PRA Revision: NONE

Question 952.65

The staff has reviewed the test facility design and matrix for the automatic depressurization system (ADS) Phase B in the VAPORE facility, in view of the recent changes in the ADS design and actuation logic. The facility design and test matrix appear to be acceptable in most respects. However, it is unclear how the liquid flow rate is to be measured in those tests where saturated liquid is used from the water/steam reservoir. If these measurements are to be made indirectly, based on the level in the reservoir, the staff believes that such a method does not give a sufficiently accurate instantaneous measurement of flow rate. The staff concludes that a flowmeter to measure liquid flow rate would be a valuable addition to the facility instrumentation. Address this concern.

Response:

Using a delta-pressure transmitter on the water/steam supply tank provides the most accurate measurement of the liquid flow rate through the VAPORE supply piping, ADS pipe/valve package, and discharge line to the quench pool. This is especially true since the flow rate during the test blowdowns is essentially constant for approximately 30 seconds, which makes instantaneous flow measurement capability (even if such a measurement were feasible) unnecessary.

SSAR Revision: None
PRA Revision: None

Question 952.79

The test procedure entitled, "AP600, SPES-2 FHFP Integral System Test-2; CL Break Matrix Test No. 3," states that the upper head average temperature of the SPES-2 facility must be 296 ± 5 degrees Celsius. This temperature is 20 degrees Celsius warmer than cold leg temperatures. How will the temperature in the upper head be raised to this initial condition if it only sees the bypass coolant fluid, which would be at nearly the same temperature as the cold leg fluid? Has this desired temperature been achieved in tests to date?

Response:

The target initial conditions specified in the test procedure were established prior to conducting the SPES-2 tests and are not required by the test specification. The upper head temperature specified in the test procedure was based on the expected AP600 plant upper head temperature.

Operation of SPES-2 has shown that the upper head is always slightly less than the cold leg temperature due to heat losses. The upper head temperature is raised as high as practical for each test and then the measured upper head temperature is documented as acceptable.

SSAR Revision: NONE
PRA Revision: NONE

Question 230.63

The soil column properties for horizontal and vertical (P-wave) models are not consistent. Specifically, (a) the damping ratio for S & P wave motions are different, and (b) Poisson's ratio for soils above the ground water table appear to be too high. Provide an explanation to justify (a) the use of same properties for the horizontal and vertical models, and (b) the use of a high Poisson's ratio in the analysis.

Response: (Revision 2)

The strain-compatible soil/rock shear modulus and damping (for shear wave) were obtained from the average properties of two SHAKE analysis results of the respective soil/rock profile using H1 and H2 time histories as described in Section 2A.4 of the SSAR. These properties shown in Tables 2A-9 through 2A-12 were subsequently used in the SSI analysis. Along with these properties, the P-wave velocity and the damping associated for P-wave were obtained and used in the SSI analyses. The SSAR revision identified below provides the requested explanation.

a. ~~The generic strain-dependent shear wave damping curves for soil/rock materials were obtained from a collection of laboratory test results as a function of shear strain amplitude. No comprehensive study to measure P-wave damping has been conducted. It is generally assumed that P-wave and S-wave damping are the same. This assumption was used for AP600. The following study was performed to evaluate the effect of P-wave damping.~~

~~The soft-to-medium soil profile with P-wave velocity of 5,000 ft/sec was analyzed using SHAKE in two cases. In Case 1, the P-wave damping was assumed to be the same as the S-wave damping (shown on Table 2A-10). In Case 2, the P-wave damping was computed using~~

$$\beta_p = \frac{4}{3}\left(\frac{V_s}{V_p}\right) \quad \beta_s$$

~~The above relationship is based on zero dissipation for volumetric changes. The values for β_s and V_s were obtained from Table 2A-10 and V_p was assumed to be 5,000 ft/sec. If β_p was found to be less than 0.1 percent, the minimum of 0.1 percent was used. The response spectra in the free field at the depth of 40 ft corresponding to the basemat elevation are compared in Figure 230.63-1. The results are almost identical such that the curves for the two cases are essentially superimposed. The results are not affected by the P-wave damping ratio. This is due to the fact that the soil column frequency at 40 ft depth is larger than 31 Hertz and the input motion at ground surface is effectively retained at the basemat level in the free field. For this reason, use of smaller P-wave damping values is not expected to affect SSI responses significantly.~~

b. ~~The P-wave velocity for each layer in the soil/rock profile was obtained from the strain-compatible shear wave velocity and the Poisson's ratios shown in Section 2A.4. The calculated P-wave velocities are also shown in Tables 2A-9 through 2A-12. Depending on the SSI case and depth to the water table, the Poisson's ratios of the submerged layers were adjusted, if necessary, to maintain the P-wave velocity of the water (5,000 ft/sec). This adjustment of P-wave velocity and hence, the Poisson's ratio, is needed to reflect the P-wave propagation~~

~~speed in saturated media. The Poisson's ratio for layers above the water table are typical values appropriate for each respective soil profile. The SSI results, particularly the horizontal responses, are believed to be insensitive to the change of Poisson's ratio. On the other hand, the vertical responses for each soil/rock case were governed by the respective shallow water table case due to the fact that use of P-wave velocity of water results in less attenuation of motion with depth, thus resulting in large effective foundation motion. The parametric SSI study on depth to the water table concluded that the water table at grade level is the governing condition for each respective generic soil profile analyzed. For these cases, the Poisson's ratio is assumed such that the P-wave velocity of the water is maintained.~~

SSAR Revision:

Add the following paragraphs in Section 2A.4 at the end of the subsection titled "Free-Field Analysis Cases":

The generic strain-dependent shear wave damping curves for soil/rock materials were obtained from a collection of laboratory test results as a function of shear strain amplitude. No comprehensive study to measure P-wave damping has been conducted. P-wave and S-wave damping are assumed to be the same. A study was performed to evaluate the effect of P-wave damping. The soft-to-medium soil profile with P-wave velocity of 5,000 ft/sec was analyzed using SHAKE in two cases. In Case 1, the P-wave damping was assumed to be the same as the S-wave damping (shown on Table 2A-10). In Case 2, the P-wave damping was computed using

$$\beta_p = \frac{4}{3}\left(\frac{V_s}{V_p}\right) \beta_s$$

This relationship is based on zero dissipation for volumetric changes. The values for β_s and V_s were obtained from Table 2A-10 and V_p was assumed to be 5,000 ft/sec. If β_p was found to be less than 0.1 percent, the minimum of 0.1 percent was used. The response spectra in the free-field at the depth of 40 ft corresponding to the basemat elevation are compared in Figure 2A-32. The results are almost identical such that the curves for the two cases are essentially superimposed. The results are not affected by the P-wave damping ratio. This is due to the fact that the soil column frequency at 40 ft depth is larger than 31 Hertz and the input motion at ground surface is effectively retained at the basemat level in the free-field. For this reason, use of smaller P-wave damping values is not expected to affect SSI responses significantly.

The P-wave velocity for each layer in the soil/rock profile was obtained from the strain-compatible shear wave velocity and the Poisson's ratios shown in Section 2A.4. The calculated P-wave velocities are also shown in Tables 2A-9 through 2A-12. Depending on the SSI case and depth to the water table, the Poisson's ratios of the submerged layers were adjusted, if necessary, to maintain the P-wave velocity of the water (5,000 ft/sec). This adjustment of P-wave velocity and hence, the Poisson's ratio, is needed to reflect the P-wave propagation speed in saturated media. The Poisson's ratio for layers above the water table are typical values appropriate for each respective soil profile. The SSI results, particularly the horizontal responses, are believed to be insensitive to the change of Poisson's ratio. On the other hand, the vertical responses for each soil/rock case were governed by the respective shallow water table case due to the fact that use of P-wave velocity of water results in less attenuation of motion with depth, thus resulting in large effective foundation motion. The parametric SSI study on depth to the water table concluded that the water table at grade level is the governing condition for each respective generic soil profile analyzed. For these cases, the Poisson's ratio is assumed such that the P-wave velocity of the water is maintained.

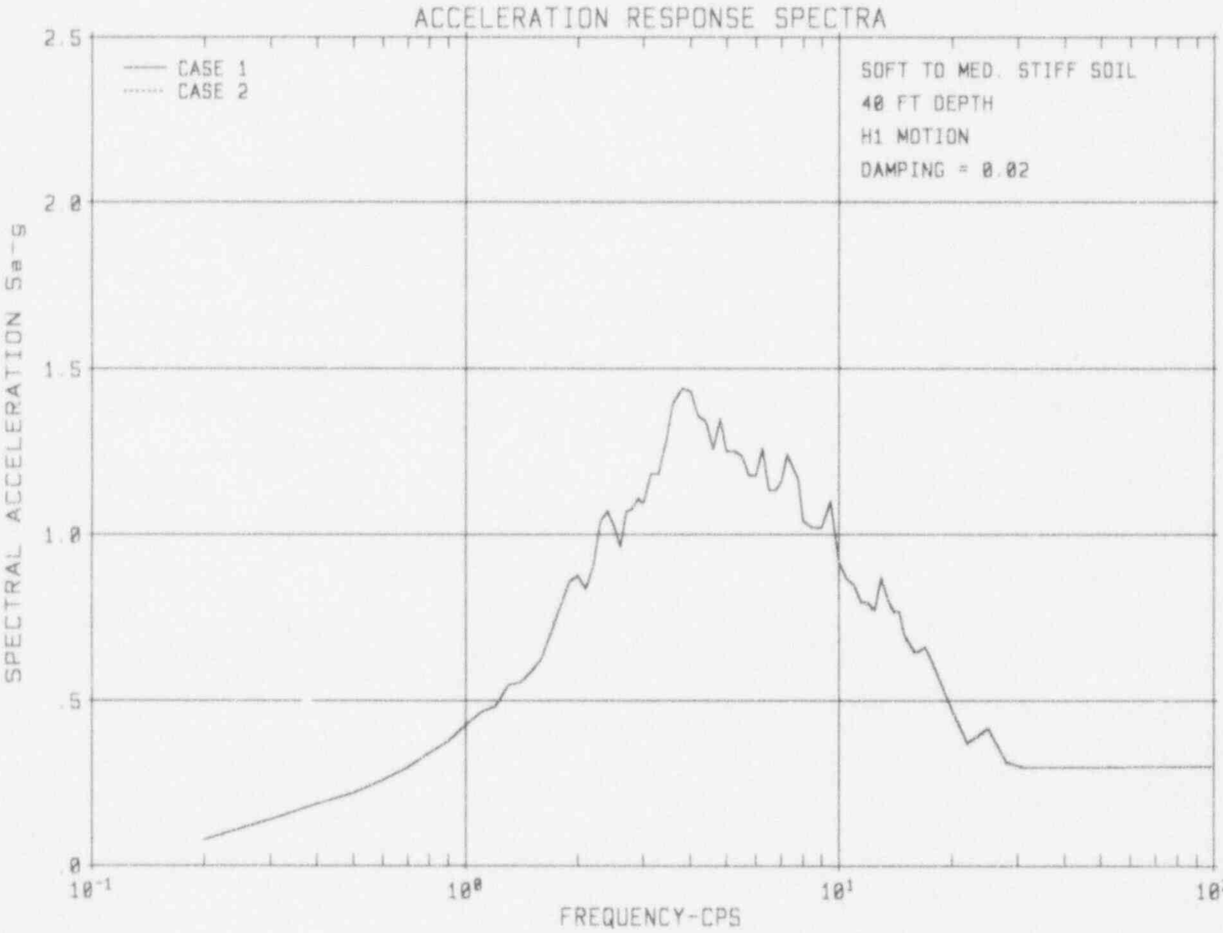

Figure 2A-32
Effect of P Wave Damping

Question 440.118

In the TS sections regarding the passive safety systems, e.g., LCO 3.4.12 for the ADS, and LCO 3.5 for the PXS, a majority of the required action completion times and SR frequencies are not given, but indicated "TBD." Section 16.1.1 of the SSAR indicates that "TBD" is for those cases where the detailed design, equipment selection, or other efforts are not sufficiently complete to establish the information required to be specified in TS, and that some of the information, such as the established startup testing, will not be available until a plant is constructed.

a. These allowed outage times and surveillance frequencies are important information in the staff's evaluation of the acceptability of these safety systems and their associated TSs. Define which items defined as "TBD" are due to the lack of a detailed design that will not be available until the plant is constructed, and which items will be completed before plant construction, and the date that they will be provided for staff review.

b. For those items that are not available prior to construction, provide bounding values.

c. Because modifications have been made to the PXS system component (e.g., ADS) designs as described in the AP600 Design Change Description Report, dated February 15, 1994, revise the corresponding TSs (e.g., TS 3.4.12) to be consistent with the new design.

Response:

a. The technical specification LCOs 3.4.12 for the ADS and 3.5 for the PXS are being revised to provide separate LCOs for this equipment in Modes 1 to 4 and in Modes 5 and 6. The revised LCOs will identify the allowed outage (completion) times and surveillance frequencies. See the response to RAI 630.9 for additional information concerning those items identified as "TBD".

   See the reponse to RAI 440.58 for information on the development of revised technical specifications for shutdown conditions.

b. The revised LCOs will identify the allowed outage (completion) times and surveillance frequencies and, therefore, bounding values are not required.

c. The revision to technical specification LCO 3.4.12 will be consistent with the revised ADS design described in the AP600 Design Change Description Report (February 1994).

SSAR Revision: NONE

The revised technical specifications, along with revised bases for each of the revised technical specifications will be included in Revision 2 of the AP600 SSAR.