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

ATTENTION: T. R. QUAY

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

Dear Mr. Quay:

Enclosed are three copies of the Westinghouse responses to NRC requests for additional information on the AP600 topics. Responses to RAIs 410.276, 410.278, 410.284, 410.287, 410.290, 410.292, 410.293, 410.294, 440.354, 440.355, 471.24, and 952.98 are attached in this transmittal.

The NRC technical staff should review these responses as a part of their review of the AP600 design. These responses close the RAIs.

Please contact Brian A. McIntyre on (412) 374-4334 if you have any questions concerning this transmittal.

Brian A. McIntyre

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

/nja

Enclosures

cc: T. Kenyon, NRC (w/o enclosures)
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Question 410.276

Re: SSAR Section 9.4.1, Nuclear Island Nonradioactive Ventilation System

Table 9.4.1-1 of the SSAR identifies assumed in-leakages through the Main Control Room (MCR) access doors and the MCR/Technical Support Center (TSC) equipment ductwork (operating) and out leakages through the MCR structure and the through MCR/TSC Heating, Ventilation and Air Conditioning (HVAC) equipment and ductwork (operating). Westinghouse should state that during abnormal operation with high airborne radioactivity conditions, the MCR/TSC HVAC subsystem can limit the doses to the control room operators to General Design Criteria (GDC) 19 dose limits given the assumed in-and out-leakages.

Response:

The "Abnormal Plant Operation" portion of SSAR subsection 9.4.1.2.3.1 (Main Control Room/Technical Support Center HVAC Subsystem), Revision 7, states that the rates shown in Table 9.4.1-1 "maintain operator doses within allowable limits." The GDC 19 portion of SSAR subsection 3.1.2, Revision 7, explicitly states that shielding and HVAC design limit doses in the main control room to less than the required 5 rem whole-body, or its equivalent, during the accident.

SSAR Revision: NONE

Question 410.278

Re: SSAR section 9.4.8, Radwaste Building HVAC System

The Westinghouse should state in Section 9.4.8 of the SSAR that (1) fire dampers are provided at duct penetrations through fire barriers to maintain the fire resistance ratings of the barriers and meet the design and installation requirements of UL-555 (1990), (2) VRS (radwaste building ventilation system) mobile filtration units, including HEPA filters, conforming the guidance of RG 1.140, Positions C.1 and C.2, (3) the supply and exhaust air system ductwork is designed, fabricated and installed to conform with the requirements of Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards, and (4) shielding of components and personnel during normal plant operation is commensurate with radiation sources in the vicinity of the VRS equipment.

Response:

The AP600 SSAR addresses these concerns as follows:

(1) The fire dampers for the radwaste building HVAC system and their applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(2) Mobile filtration units for the radwaste building are the responsibility of the COL holder. Applicable requirements related to Design Certification are contained in the Combined License Information subsections of SSAR Chapter 11 which describe the Radwaste systems.

(3) The ductwork for the radwaste building HVAC system and its applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(4) The shielding design for the radwaste building is described in SSAR section 12.3.

SSAR Revision: NONE

Question 410.284

Section 9.2.7.2.1 of the SSAR (Revision 3) states that the high capacity subsystem consists of two chilled water pumps, two water-cooled chillers, a chemical feed tank, and an expansion tank. An air separator was eliminated from the previous SSAR revision. However, each of the two loops of the low capacity subsystem still contains of an air separator and other components that are similar to the high capacity subsystem. Explain why the air separator is not required in the high capacity subsystem.

Response:

SSAR subsection 9.2.7.2.1, Revision 6, properly describes the low capacity subsystem without an air separator. Air separators are not required since the expansion tank is sized and located to serve this function.

SSAR Revision: NONE

Question 410.287

Section 9.2.10.3 of the SSAR (Revision 3) states that the hot water heating system (VYS) is a high energy system and has no safety-related function. Provide information regarding the system pressure and temperature and verify that any failure of the VYS piping or equipment will not directly or indirectly result in lose of required redundancy in any portion of the systems or equipment in the safety-related areas. Also, explain why the system was changed to a high-energy system from a moderate-energy system.

Response:

SSAR subsection 9.2.10.3, Revision 6, provides the basis for hot water system's non-safety-related functional status. The specification change from moderate-energy to high-energy was made to ensure its ability to provide hot water under all design conditions.

SSAR Revision: NONE

Question 410.290

Section 9.2.10.5 of the SSAR (Revision 3) states that instruments are provided for monitoring system parameters. Essential system parameters are monitored in the main control room via information taken from the hot water heating system through the plant data display and processing system. What are the essential system parameters related to the hot water heating system. The instruments for the heat exchanger and pumps were initially designed locally on the piping system. Do these instruments provide indication in the control room for the hot water heating system after the design change?

Response:

SSAR subsection 9.2.10, Revision 6, states that the hot water heating system serves no safety-related function and therefore has no nuclear safety design basis. The information provided in the subsection is sufficient for review of the system's potential for impact on the safety of the plant. The subsection also states that instruments are provided for monitoring system parameters and that essential system parameters are monitored in the main control room. Process signals provided by the hot water system instrumentation are communicated to the monitor bus of the data display and processing system. As a result, any of the system instruments can be monitored or displayed in the control room. Local display is also provided as requested by the roving operator on a portable display device. Normal operating display of system parametric data will be developed after Design Certification as part of the man-machine interface, human factors engineering process described in Chapter 18 of the SSAR.

SSAR Revision: NONE

Question 410.292

In Section 10.4.9.2.1 of the SSAR (Revision 4), Westinghouse changed the pump capacity of the startup feedwater system to two 50-percent from two 100-percent pumps. Section 10.4.9.1.2 of the SSAR, Item H, states that two startup feedwater pumps are provided with a single pump capable of satisfying the startup feedwater system flow for decay heat removal. Justify how a single 50-percent capacity pump (with one pump in standby) can satisfy the flow demand and redundancy requirements.

Response:

The Startup Feedwater Pump portion of SSAR subsection 10.4.9.2.2, Revision 6, is consistent with subsection 10.4.9.1.2. Each startup feedwater pump can supply 100 percent of the required flow to the steam generators to meet decay heat requirements.

SSAR Revision: NONE

Question 410.293

Section 10.4.9.1.1 of the SSAR (Revision 4) states, in part, that the startup feedwater control valves (SFCVs) and startup feedwater isolation valves (SFIVs) are designed to close on an appropriate engineered safety signal (startup feedwater isolation signal) and the SFIV also serves as a containment isolation valve. Before the design change, Section 10.4.7.1.1 of the SSAR stated that the SFIV serves as a containment isolation valve and closes on a containment isolation signal. Explain why the SFIV should not close on a containment isolation signal. Containment isolation provisions require auxiliary feedwater isolation valves to have remote manually close feature whenever containment isolation is required.

Response:

SSAR subsections 10.4.7.1.1 and 10.4.9.1.1, Revision 6, include a more consistent description of safety related functions of the main and startup feedwater control and isolation valves. Subsection 10.4.7.1.1 discusses only main feedwater system functions and components. Subsection 10.4.9.1.1 discusses only startup feedwater functions and components. Bullet sections of subsection 10.4.9.1.1 are intended to reinforce the first paragraph of the subsection. The design changes to the feedwater system have not modified the safety related logic for automatic isolation of the startup feedwater isolation valves. The startup feedwater isolation valve serves a containment isolation function and closes on an ESF signal indicative of the need to isolate startup feedwater while retaining the defense in depth function of the system. Section 7.3 provides the functional diagrams for closure and subsection 6.2.3 identifies eacn containment penetration and the ESF signal provided to close the remotely operated containment isolation valves. The valves can also be opened after isolation or closed by a remote manual signal.

SSAR Revision: NONE

Question 410.294

Section 10.4.9 of the SSAR (Revision 4) does not address water hammer problem in the startup feedwater system. Westinghouse added a paragraph in Section 5.4.2.2 of the SSAR (Revision 4) to address the design change by using a separate startup feedwater delivery system connected to the steam generator. However, the information provided in the section regarding water hammer occurrence in the startup feedwater piping is not adequate. Section 5.4.2.2 states, in part, that prevention and mitigation of feedline-related water hammer has been accomplished through an improved design and the layout of the startup feedwater piping includes the same features as the main feedwater line to minimize the potential for water hammer. Provide information on the improved design and design features for water hammer prevention for the startup feedwater system.

Response:

The Main Feedwater Line portion of SSAR Appendix 3B, subsection 3B.2.3, Revision 7, provides a more detailed discussion of the AP600 design features for minimizing water hammer, including piping layout features. The statup feedwater piping layout includes similar features as the main feedwater piping layout, indicated in SSAR subsection 5.4.2.2. These features include: a downward elbow in close proximity to the steam generator startup feedwater nozzle, exclusion of high points limiting void collection, redundant positive isolation to prevent back leakage, and delivery of startup feedwater to steam generator independent of feed rings.

SSAR Revision: NONE

Question 440.354

Re: WCAP-14171 (WCOBRA/TRAC CAD)
Accumulator injection will be followed by injection of the nitrogen pressurizing gas. An issue to be resolved is the successful CMT/in containment reactor water storage tank (IRWST) gravity draining in the presence of the pressurization effect of the cover gas. Identify the applicable assessment data, provide comparisons between the test data and WCOBRA/TRAC calculations to demonstrate the code is capable of correctly modeling CMT/IRWST draining in the presence of nitrogen, and demonstrate the acceptability of the LTC LBLOCA methodology to be used for the evaluation of the AP600 LTC response.

Response:

The long term cooling portion of the AP600 LOCA transients begins when IRWST injection is initiated. This does not occur until after the core makeup tank has drained to its Low-2 level setpoint, which actuates the IRWST isolation valves. During a postulated large break LOCA event, minimal injection of CMT liquid occurs until the accumulator has emptied. The interaction of gas flowing from the empty accumulator with safety injection flow will occur within the initial time frame of the large break LOCA event and will occur with CMT injection, not with IRWST flow delivery.

The WCOBRA/TRAC computation of AP600 core makeup tank draining in the presence of accumulator nitrogen injection involves prediction of similar phenomena to those which occur during the large break LOCA accumulator gas release in conventional plants at a similar time in the transient. During its review by NRC as a large break LOCA code, WCOBRA/TRAC was extensively validated for the prediction of non-condensible gas effects, documentation of which is presented in Reference 440.354-1; the code is shown to predict these effects well for coincident gas and liquid flow into common piping. The application of the same one-dimensional component modeling of non-condensible gas interactions with safety injection flow in the AP600 direct vessel injection line is within the established capability of the code.

WCOBRA/TRAC capability for modeling gravity-driven flows from the core makeup tanks has been validated by prediction of pertinent CMT test facility results (Reference 440.354-2). The range of tests conducted in the CMT test facility includes tests which simulated the delayed draining condition typical of large break LOCA events. Ultimately, any nitrogen injected into the reactor vessel through the DVI line will either flow through the break or make its way to a high point within the reactor coolant system. If it does proceed through the CMT balance line up to the top of the CMT, the gas will enhance the delivery of CMT liquid into the reactor vessel during a large break LOCA event. If it rises to any other high elevation location in the reactor coolant system, it will have no impact on the CMT delivery during the large break LOCA transient. In either case, CMT gravity injection proceeds because the pressure driving force associated with a full CMT is large, and the reactor coolant system is basically at pressure equilibrium once a small amount of accumulator nitrogen is delivered when the tank initially empties of liquid. Overall, the prediction of CMT flow delivery in the presence of accumulator nitrogen in the DVI lines utilizes already validated capabilities of the WCOBRA/TRAC computer code.

AP600

References:

440.354-1 Bajorek, S.M. et. al., "Code Qualification Document for Best Estimate Analysis," WCAP-1945-P, Revision 1 (Proprietary), Volume 3, Chapter 16, Section 16-2.

440.354-2 Haberstroh, R.C. et. al. MT01-GSR-003, "WCOBRA/TRAC Core Makeup Tank Preliminary Validation Report," February, 1995.

SSAR Revision: NONE

Question 440.355

Re: WCAP-14171 (WCOBRA/TRAC CAD)
If extended core boiloff occurs, boric acid will accumulate and precipitate interfering with the ability to maintain core cooling. Therefore, subcooled liquid throughput must be demonstrated in the LTC mode that will maintain boric acid concentration within acceptable limits. Please describe the methodology and how it will be used to evaluate this issue; include applicable code/data comparisons demonstrating WCOBRA/TRAC's ability to correctly calculate this LTC mode.

Response:

The long-term cooling pattern established in the AP600 is equivalent to that in conventional Westinghouse plants for a hot leg break location: continuous injection into the cold leg (downcomer injection in AP600) provides a flushing flow through the core and out through the break (ADS stage 4 flow paths in AP600) which precludes concentration of boric acid in the core to a level which might approach the solubility limit. In neither case is boiling necessarily terminated in the core by a specified time, nor is it necessary to create a subcooled fluid condition to achieve effective long term cooling of the core.

Significant, essentially continuous liquid flow through the core was observed in the long-term cooling phase of the tests performed at the Oregon State University test facility. A WCOBRA/TRAC long-term cooling model validated against the OSU long-term cooling test data (Reference 440.355-1) is applied to calculate the long term post-LOCA reactor coolant system and core conditions in AP600. The WCOBRA/TRAC analysis is performed in conjunction with a WGOTHIC code prediction of the AP600 long term containment performance (Reference 440.355-2). WGOTHIC predicts that the AP600 containment sump fluid temperature will ultimately approach saturation during post-LOCA long-term cooling.

References:

440.355-1 LTCT-GSR-003, "WCOBRA/TRAC OSU Long-Term Cooling Preliminary Validation Report," August, 1995.

440.355-2 Revised response to RAI 440.554 (defining the WC/T - WGOTHIC code interface methodology), May, 1996.

SSAR Revision: NONE

Question 471.24

Section 11.5.6 of Chapter 11 of the SSAR states that criticality monitors as required in 10 CFR 70.24 and Regulatory Guide 8.12 are not provided because the design of the fuel pool racks precludes criticality under postulated normal and accident conditions. Justify why criticality monitors are not required and state the requirements that the COL applicant will need to fulfill this requirement.

Response:

Section 70.24 of 10 CFR Part 70 requires a criticality monitoring system for areas containing greater than the specified quantities of special nuclear material. Section 70.24 (c) exempts these requirements for power reactors such as AP600 and Section 70.24 (d) states: "Any licensee who believes that good cause exists why he should be granted an exemption in whole or in part from the requirements of this section may apply to the Commission for such exemption. Such application shall specify his reason for the relief requested." Regulatory Guide 8.12, Section C, Regulatory Position, states: "If ... an evaluation [of the need for criticality alarms in an area] does not determine that a potential for criticality exists, as for example where the quantities or form of special nuclear material make criticality practically impossible or where geometric spacing is used to preclude criticality, such as in some storage spaces for unirradiated nuclear power plant fuel, it is appropriate to request an exemption from section 70.24."

The fuel storage racks for AP600 are designed to prevent criticality under the normal and postulated accident conditions as defined in ANSI/ANS-57.2-1983 and ANSI/ANS-57.3-1983. This includes a criticality analysis of all storage racks such that the multiplication factor, K_{eff}, is less than 0.95 including appropriate uncertainties and biases.

The design of the fuel storage rack is such that it maintains K_{eff} less than 0.95 through the use of geometric spacing and neutron absorbers to limit neutron interaction between fuel assemblies. The K_{eff} limit of 0.95 is not exceeded for all postulated accident conditions, beyond normal storage conditions, based on the double contingency principle of ANSI/ANS-8.1-1983. Therefore, if a criticality analysis has proven that each storage rack design is subcritical, K_{eff} less than 0.95, for possible normal and postulated accident storage configurations, there is no need for a criticality accident alarm system.

The AP600 SSAR includes the information necessary to justify an exemption to 10 CFR 70.24. SSAR sections 9.1.1.3 and 9.1.2.3 provide descriptions of the geometric prevention of criticality for new and spent fuel racks, respectively. SSAR section 9.1.6 includes combined license applicant requirements to confirm criticality calculations for both new and spent fuel racks. SSAR subsection 11.5.6 states that critically monitoring functions are performed by the area radiation monitors in combination with portable bridge monitors.

SSAR Revision: None

Question 952.98

Provide a commitment to submit inservice inspection (ISI) and inservice testing (IST) plans for check valves to include measurements of differential pressure required to initiate flow and the flow required to fully open the tested valve.

Response:

SSAR sections 5.2.4 and 6.6 provide the inservice inspection plans for valves, including check valves. Section 3.9.6 and Table 3.9-16 provide IST plans, including details for the check valves in the passive core cooling system (PXS). The safety related check valves in this system with low differential pressure opening or closing requirements are those in the containment recirculation and IRWST lines. Both sets of valves will be tested for differential pressure required to initiate flow and for full flow. Containment recirculation check valves will be tested mechanically and the IRWST injection check valve by differential pressure methods. Revision 5 of SSAR section 3.9.6 did not revise these requirements and the planned revision of Table 3.9-16 will not include changes to these requirements. Other safety related check valves in PXS (CMT and accumulator discharge) are also included in Table 3.9-16.

SSAR Revision: None

Question 410.276

Re: SSAR Section 9.4.1, Nuclear Island Nonradioactive Ventilation System

Table 9.4.1-1 of the SSAR identifies assumed in-leakages through the Main Control Room (MCR) access doors and the MCR/Technical Support Center (TSC) equipment ductwork (operating) and out leakages through the MCR structure and the through MCR/TSC Heating, Ventilation and Air Conditioning (HVAC) equipment and ductwork (operating). Westinghouse should state that during abnormal operation with high airborne radioactivity conditions, the MCR/TSC HVAC subsystem can limit the doses to the control room operators to General Design Criteria (GDC) 19 dose limits given the assumed in-and out-leakages.

Response:

The "Abnormal Plant Operation" portion of SSAR subsection 9.4.1.2.3.1 (Main Control Room/Technical Support Center HVAC Subsystem), Revision 7, states that the rates shown in Table 9.4.1-1 "maintain operator doses within allowable limits." The GDC 19 portion of SSAR subsection 3.1.2, Revision 7, explicitly states that shielding and HVAC design limit doses in the main control room to less than the required 5 rem whole-body, or its equivalent, during the accident.

SSAR Revision: NONE

Question 410.278

Re: SSAR section 9.4.8, Radwaste Building HVAC System

The Westinghouse should state in Section 9.4.8 of the SSAR that (1) fire dampers are provided at duct penetrations through fire barriers to maintain the fire resistance ratings of the barriers and meet the design and installation requirements of UL-555 (1990), (2) VR'S (radwaste building ventilation system) mobile filtration units, including HEPA filters, conforming the guidance of RG 1.140, Positions C.1 and C.2, (3) the supply and exhaust air system ductwork is designed, fabricated and installed to conform with the requirements of Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards, and (4) shielding of components and personnel during normal plant operation is commensurate with radiation sources in the vicinity of the VRS equipment.

Response:

The AP600 SSAR addresses these concerns as follows:

(1) The fire dampers for the radwaste building HVAC system and their applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(2) Mobile filtration units for the radwaste building are the responsibility of the COL holder. Applicable requirements related to Design Certification are contained in the Combined License Information subsections of SSAR Chapter 11 which describe the Radwaste systems.

(3) The ductwork for the radwaste building HVAC system and its applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(4) The shielding design for the radwaste building is described in SSAR section 12.3.

SSAR Revision: NONE

Question 410.284

Section 9.2.7.2.1 of the SSAR (Revision 3) states that the high capacity subsystem consists of two chilled water pumps, two water-cooled chillers, a chemical feed tank, and an expansion tank. An air separator was eliminated from the previous SSAR revision. However, each of the two loops of the low capacity subsystem still contains of an air separator and other components that are similar to the high capacity subsystem. Explain why the air separator is not required in the high capacity subsystem.

Response:

SSAR subsection 9.2.7.2.1, Revision 6, properly describes the low capacity subsystem without an air separator. Air separators are not required since the expansion tank is sized and located to serve this function.

SSAR Revision: NONE

Question 410.287

Section 9.2.10.3 of the SSAR (Revision 3) states that the hot water heating system (VYS) is a high energy system and has no safety-related function. Provide information regarding the system pressure and temperature and verify that any failure of the VYS piping or equipment will not directly or indirectly result in lose of required redundancy in any portion of the systems or equipment in the safety-related areas. Also, explain why the system was changed to a high-energy system from a moderate-energy system.

Response:

SSAR subsection 9.2.10.3, Revision 6, provides the basis for hot water system's non-safety-related functional status. The specification change from moderate-energy to high-energy was made to ensure its ability to provide hot water under all design conditions.

SSAR Revision: NONE

Question 410.290

Section 9.2.10.5 of the SSAR (Revision 3) states that instruments are provided for monitoring system parameters. Essential system parameters are monitored in the main control room via information taken from the hot water heating system through the plant data display and processing system. What are the essential system parameters related to the hot water heating system. The instruments for the heat exchanger and pumps were initially designed locally on the piping system. Do these instruments provide indication in the control room for the hot water heating system after the design change?

Response:

SSAR subsection 9.2.10, Revision 6, states that the hot water heating system serves no safety-related function and therefore has no nuclear safety design basis. The information provided in the subsection is sufficient for review of the system's potential for impact on the safety of the plant. The subsection also states that instruments are provided for monitoring system parameters and that essential system parameters are monitored in the main control room. Process signals provided by the hot water system instrumentation are communicated to the monitor bus of the data display and processing system. As a result, any of the system instruments can be monitored or displayed in the control room. Local display is also provided as requested by the roving operator on a portable display device. Normal operating display of system parametric data will be developed after Design Certification as part of the man-machine interface, human factors engineering process described in Chapter 18 of the SSAR.

SSAR Revision: NONE

Question 410.292

In Section 10.4.9.2.1 of the SSAR (Revision 4), Westinghouse changed the pump capacity of the startup feedwater system to two 50-percent from two 100-percent pumps. Section 10.4.9.1.2 of the SSAR, Item H, states that two startup feedwater pumps are provided with a single pump capable of satisfying the startup feedwater system flow for decay heat removal. Justify how a single 50-percent capacity pump (with one pump in standby) can satisfy the flow demand and redundancy requirements.

Response:

The Startup Feedwater Pump portion of SSAR subsection 10.4.9.2.2, Revision 6, is consistent with subsection 10.4.9.1.2. Each startup feedwater pump can supply 100 percent of the required flow to the steam generators to meet decay heat requirements.

SSAR Revision: NONE

Question 410.293

Section 10.4.9.1.1 of the SSAR (Revision 4) states, in part, that the startup feedwater control valves (SFCVs) and startup feedwater isolation valves (SFIVs) are designed to close on an appropriate engineered safety signal (startup feedwater isolation signal) and the SFIV also serves as a containment isolation valve. Before the design change, Section 10.4.7.1.1 of the SSAR stated that the SFIV serves as a containment isolation valve and closes on a containment isolation signal. Explain why the SFIV should not close on a containment isolation signal. Containment isolation provisions require auxiliary feedwater isolation valves to have remote manually close feature whenever containment isolation is required.

Response:

SSAR subsections 10.4.7.1.1 and 10.4.9.1.1, Revision 6, include a more consistent description of safety related functions of the main and startup feedwater control and isolation valves. Subsection 10.4.7.1.1 discusses only main feedwater system functions and components. Subsection 10.4.9.1.1 discusses only startup feedwater functions and components. Bullet sections of subsection 10.4.9.1.1 are intended to reinforce the first paragraph of the subsection. The design changes to the feedwater system have not modified the safety related logic for automatic isolation of the startup feedwater isolation valves. The startup feedwater isolation valve serves a containment isolation function and closes on an ESF signal indicative of the need to isolate startup feedwater while retaining the defense in depth function of the system. Section 7.3 provides the functional diagrams for closure and subsection 6.2.3 identifies each containment penetration and the ESF signal provided to close the remotely operated containment isolation valves. The valves can also be opened after isolation or closed by a remote manual signal.

SSAR Revision: NONE

Question 410.294

Section 10.4.9 of the SSAR (Revision 4) does not address water hammer problem in the startup feedwater system. Westinghouse added a paragraph in Section 5.4.2.2 of the SSAR (Revision 4) to address the design change by using a separate startup feedwater delivery system connected to the steam generator. However, the information provided in the section regarding water hammer occurrence in the startup feedwater piping is not adequate. Section 5.4.2.2 states, in part, that prevention and mitigation of feedline-related water hammer has been accomplished through an improved design and the layout of the startup feedwater piping includes the same features as the main feedwater line to minimize the potential for water hammer. Provide information on the improved design and design features for water hammer prevention for the startup feedwater system.

Response:

The Main Feedwater Line portion of SSAR Appendix 3B, subsection 3B.2.3, Revision 7, provides a more detailed discussion of the AP600 design features for minimizing water hammer, including piping layout features. The statup feedwater piping layout includes similar features as the main feedwater piping layout, indicated in SSAR subsection 5.4.2.2. These features include: a downward elbow in close proximity to the steam generator startup feedwater nozzle, exclusion of high points limiting void collection, redundant positive isolation to prevent back leakage, and delivery of startup feedwater to steam generator independent of feed rings.

SSAR Revision: NONE

Question 440.354

Re: WCAP-14171 (WCOBRA/TRAC CAD)
Accumulator injection will be followed by injection of the nitrogen pressurizing gas. An issue to be resolved is the successful CMT/in containment reactor water storage tank (IRWST) gravity draining in the presence of the pressurization effect of the cover gas. Identify the applicable assessment data, provide comparisons between the test data and WCOBRA/TRAC calculations to demonstrate the code is capable of correctly modeling CMT/IRWST draining in the presence of nitrogen, and demonstrate the acceptability of the LTC LBLOCA methodology to be used for the evaluation of the AP600 LTC response.

Response:

The long term cooling portion of the AP600 LOCA transients begins when IRWST injection is initiated. This does not occur until after the core makeup tank has drained to its Low-2 level setpoint, which actuates the IRWST isolation valves. During a postulated large break LOCA event, minimal injection of CMT liquid occurs until the accumulator has emptied. The interaction of gas flowing from the empty accumulator with safety injection flow will occur within the initial time frame of the large break LOCA event and will occur with CMT injection, not with IRWST flow delivery.

The WCOBRA/TRAC computation of AP600 core makeup tank draining in the presence of accumulator nitrogen injection involves prediction of similar phenomena to those which occur during the large break LOCA accumulator gas release in conventional plants at a similar time in the transient. During its review by NRC as a large break LOCA code, WCOBRA/TRAC was extensively validated for the prediction of non-condensible gas effects, documentation of which is presented in Reference 440.354-1; the code is shown to predict these effects well for coincident gas and liquid flow into common piping. The application of the same one-dimensional component modeling of non-condensible gas interactions with safety injection flow in the AP600 direct vessel injection line is within the established capability of the code.

WCOBRA/TRAC capability for modeling gravity-driven flows from the core makeup tanks has been validated by prediction of pertinent CMT test facility results (Reference 440.354-2). The range of tests conducted in the CMT test facility includes tests which simulated the delayed draining condition typical of large break LOCA events. Ultimately, any nitrogen injected into the reactor vessel through the DVI line will either flow through the break or make its way to a high point within the reactor coolant system. If it does proceed through the CMT balance line up to the top of the CMT, the gas will enhance the delivery of CMT liquid into the reactor vessel during a large break LOCA event. If it rises to any other high elevation location in the reactor coolant system, it will have no impact on the CMT delivery during the large break LOCA transient. In either case, CMT gravity injection proceeds because the pressure driving force associated with a full CMT is large, and the reactor coolant system is basically at pressure equilibrium once a small amount of accumulator nitrogen is delivered when the tank initially empties of liquid. Overall, the prediction of CMT flow delivery in the presence of accumulator nitrogen in the DVI lines utilizes already validated capabilities of the WCOBRA/TRAC computer code.

References:

440.354-1 Bajorek, S.M. et. al., "Code Qualification Document for Best Estimate Analysis," WCAP-1945-P, Revision 1 (Proprietary), Volume 3, Chapter 16, Section 16-2.

440.354-2 Haberstroh, R.C. et. al. MT01-GSR-003, "WCOBRA/TRAC Core Makeup Tank Preliminary Validation Report," February, 1995.

SSAR Revision: NONE

Question 440.355

Re: WCAP-14171 (WCOBRA/TRAC CAD)
If extended core boiloff occurs, boric acid will accumulate and precipitate interfering with the ability to maintain core cooling. Therefore, subcooled liquid throughput must be demonstrated in the LTC mode that will maintain boric acid concentration within acceptable limits. Please describe the methodology and how it will be used to evaluate this issue; include applicable code/data comparisons demonstrating WCOBRA/TRAC's ability to correctly calculate this LTC mode.

Response:

The long-term cooling pattern established in the AP600 is equivalent to that in conventional Westinghouse plants for a hot leg break location: continuous injection into the cold leg (downcomer injection in AP600) provides a flushing flow through the core and out through the break (ADS stage 4 flow paths in AP600) which precludes concentration of boric acid in the core to a level which might approach the solubility limit. In neither case is boiling necessarily terminated in the core by a specified time, nor is it necessary to create a subcooled fluid condition to achieve effective long term cooling of the core.

Significant, essentially continuous liquid flow through the core was observed in the long-term cooling phase of the tests performed at the Oregon State University test facility. A WCOBRA/TRAC long-term cooling model validated against the OSU long-term cooling test data (Reference 440.355-1) is applied to calculate the long term post-LOCA reactor coolant system and core conditions in AP600. The WCOBRA/TRAC analysis is performed in conjunction with a WGOTHIC code prediction of the AP600 long term containment performance (Reference 440.355-2). WGOTHIC predicts that the AP600 containment sump fluid temperature will ultimately approach saturation during post-LOCA long-term cooling.

References:

440.355-1 LTCT-GSR-003, "WCOBRA/TRAC OSU Long-Term Cooling Preliminary Validation Report," August, 1995.

440.355-2 Revised response to RAI 440.554 (defining the WC/T - WGOTHIC code interface methodology), May, 1996.

SSAR Revision: NONE

Question 471.24

Section 11.5.6 of Chapter 11 of the SSAR states that criticality monitors as required in 10 CFR 70.24 and Regulatory Guide 8.12 are not provided because the design of the fuel pool racks precludes criticality under postulated normal and accident conditions. Justify why criticality monitors are not required and state the requirements that the COL applicant will need to fulfill this requirement.

Response:

Section 70.24 of 10 CFR Part 70 requires a criticality monitoring system for areas containing greater than the specified quantities of special nuclear material. Section 70.24 (c) exempts these requirements for power reactors such as AP600 and Section 70.24 (d) states: "Any licensee who believes that good cause exists why he should be granted an exemption in whole or in part from the requirements of this section may apply to the Commission for such exemption. Such application shall specify his reason for the relief requested." Regulatory Guide 8.12, Section C, Regulatory Position, states: "If ... an evaluation [of the need for criticality alarms in an area] does not determine that a potential for criticality exists, as for example where the quantities or form of special nuclear material make criticality practically impossible or where geometric spacing is used to preclude criticality, such as in some storage spaces for unirradiated nuclear power plant fuel, it is appropriate to request an exemption from section 70.24."

The fuel storage racks for AP600 are designed to prevent criticality under the normal and postulated accident conditions as defined in ANSI/ANS-57.2-1983 and ANSI/ANS-57.3-1983. This includes a criticality analysis of all storage racks such that the multiplication factor, K_{eff}, is less than 0.95 including appropriate uncertainties and biases.

The design of the fuel storage rack is such that it maintains K_{eff} less than 0.95 through the use of geometric spacing and neutron absorbers to limit neutron interaction between fuel assemblies. The K_{eff} limit of 0.95 is not exceeded for all postulated accident conditions, beyond normal storage conditions, based on the double contingency principle of ANSI/ANS-8.1-1983. Therefore, if a criticality analysis has proven that each storage rack design is subcritical, K_{eff} less than 0.95, for possible normal and postulated accident storage configurations, there is no need for a criticality accident alarm system.

The AP600 SSAR includes the information necessary to justify an exemption to 10 CFR 70.24. SSAR sections 9.1.1.3 and 9.1.2.3 provide descriptions of the geometric prevention of criticality for new and spent fuel racks, respectively. SSAR section 9.1.6 includes combined license applicant requirements to confirm criticality calculations for both new and spent fuel racks. SSAR subsection 11.5.6 states that critically monitoring functions are performed by the area radiation monitors in combination with portable bridge monitors.

SSAR Revision: None

Question 952.98

Provide a commitment to submit inservice inspection (ISI) and inservice testing (IST) plans for check valves to include measurements of differential pressure required to initiate flow and the flow required to fully open the tested valve.

Response:

SSAR sections 5.2.4 and 6.6 provide the inservice inspection plans for valves, including check valves. Section 3.9.6 and Table 3.9-16 provide IST plans, including details for the check valves in the passive core cooling system (PXS). The safety related check valves in this system with low differential pressure opening or closing requirements are those in the containment recirculation and IRWST lines. Both sets of valves will be tested for differential pressure required to initiate flow and for full flow. Containment recirculation check valves will be tested mechanically and the IRWST injection check valve by differential pressure methods. Revision 5 of SSAR section 3.9.6 did not revise these requirements and the planned revision of Table 3.9-16 will not include changes to these requirements. Other safety related check valves in PXS (CMT and accumulator discharge) are also included in Table 3.9-16.

SSAR Revision: None

Question 410.276

Re: SSAR Section 9.4.1, Nuclear Island Nonradioactive Ventilation System

Table 9.4.1-1 of the SSAR identifies assumed in-leakages through the Main Control Room (MCR) access doors and the MCR/Technical Support Center (TSC) equipment ductwork (operating) and out leakages through the MCR structure and the through MCR/TSC Heating, Ventilation and Air Conditioning (HVAC) equipment and ductwork (operating). Westinghouse should state that during abnormal operation with high airborne radioactivity conditions, the MCR/TSC HVAC subsystem can limit the doses to the control room operators to General Design Criteria (GDC) 19 dose limits given the assumed in-and out-leakages.

Response:

The "Abnormal Plant Operation" portion of SSAR subsection 9.4.1.2.3.1 (Main Control Room/Technical Support Center HVAC Subsystem), Revision 7, states that the rates shown in Table 9.4.1-1 "maintain operator doses within allowable limits." The GDC 19 portion of SSAR subsection 3.1.2, Revision 7, explicitly states that shielding and HVAC design limit doses in the main control room to less than the required 5 rem whole-body, or its equivalent, during the accident.

SSAR Revision: NONE

Question 410.278

Re: SSAR section 9.4.8, Radwaste Building HVAC System

The Westinghouse should state in Section 9.4.8 of the SSAR that (1) fire dampers are provided at duct penetrations through fire barriers to maintain the fire resistance ratings of the barriers and meet the design and installation requirements of UL-555 (1990), (2) VRS (radwaste building ventilation system) mobile filtration units, including HEPA filters, conforming the guidance of RG 1.140, Positions C.1 and C.2, (3) the supply and exhaust air system ductwork is designed, fabricated and installed to conform with the requirements of Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards, and (4) shielding of components and personnel during normal plant operation is commensurate with radiation sources in the vicinity of the VRS equipment.

Response:

The AP600 SSAR addresses these concerns as follows:

(1) The fire dampers for the radwaste building HVAC system and their applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(2) Mobile filtration units for the radwaste building are the responsibility of the COL holder. Applicable requirements related to Design Certification are contained in the Combined License Information subsections of SSAR Chapter 11 which describe the Radwaste systems.

(3) The ductwork for the radwaste building HVAC system and its applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(4) The shielding design for the radwaste building is described in SSAR section 12.3.

SSAR Revision: NONE

Question 410.284

Section 9.2.7.2.1 of the SSAR (Revision 3) states that the high capacity subsystem consists of two chilled water pumps, two water-cooled chillers, a chemical feed tank, and an expansion tank. An air separator was eliminated from the previous SSAR revision. However, each of the two loops of the low capacity subsystem still contains of an air separator and other components that are similar to the high capacity subsystem. Explain why the air separator is not required in the high capacity subsystem.

Response:

SSAR subsection 9.2.7.2.1, Revision 6, properly describes the low capacity subsystem without an air separator. Air separators are not required since the expansion tank is sized and located to serve this function.

SSAR Revision: NONE

Question 410.287

Section 9.2.10.3 of the SSAR (Revision 3) states that the hot water heating system (VYS) is a high energy system and has no safety-related function. Provide information regarding the system pressure and temperature and verify that any failure of the VYS piping or equipment will not directly or indirectly result in lose of required redundancy in any portion of the systems or equipment in the safety-related areas. Also, explain why the system was changed to a high-energy system from a moderate-energy system.

Response:

SSAR subsection 9.2.10.3, Revision 6, provides the basis for hot water system's non-safety-related functional status. The specification change from moderate-energy to high-energy was made to ensure its ability to provide hot water under all design conditions.

SSAR Revision: NONE

Question 410.290

Section 9.2.10.5 of the SSAR (Revision 3) states that instruments are provided for monitoring system parameters. Essential system parameters are monitored in the main control room via information taken from the hot water heating system through the plant data display and processing system. What are the essential system parameters related to the hot water heating system. The instruments for the heat exchanger and pumps were initially designed locally on the piping system. Do these instruments provide indication in the control room for the hot water heating system after the design change?

Response:

SSAR subsection 9.2.10, Revision 6, states that the hot water heating system serves no safety-related function and therefore has no nuclear safety design basis. The information provided in the subsection is sufficient for review of the system's potential for impact on the safety of the plant. The subsection also states that instruments are provided for monitoring system parameters and that essential system parameters are monitored in the main control room. Process signals provided by the hot water system instrumentation are communicated to the monitor bus of the data display and processing system. As a result, any of the system instruments can be monitored or displayed in the control room. Local display is also provided as requested by the roving operator on a portable display device. Normal operating display of system parametric data will be developed after Design Certification as part of the man-machine interface, human factors engineering process described in Chapter 18 of the SSAR.

SSAR Revision: NONE

Question 410.292

In Section 10.4.9.2.1 of the SSAR (Revision 4), Westinghouse changed the pump capacity of the startup feedwater system to two 50-percent from two 100-percent pumps. Section 10.4.9.1.2 of the SSAR, Item H, states that two startup feedwater pumps are provided with a single pump capable of satisfying the startup feedwater system flow for decay heat removal. Justify how a single 50-percent capacity pump (with one pump in standby) can satisfy the flow demand and redundancy requirements.

Response:

The Startup Feedwater Pump portion of SSAR subsection 10.4.9.2.2, Revision 6, is consistent with subsection 10.4.9.1.2. Each startup feedwater pump can supply 100 percent of the required flow to the steam generators to meet decay heat requirements.

SSAR Revision: NONE

Question 410.293

Section 10.4.9.1.1 of the SSAR (Revision 4) states, in part, that the startup feedwater control valves (SFCVs) and startup feedwater isolation valves (SFIVs) are designed to close on an appropriate engineered safety signal (startup feedwater isolation signal) and the SFIV also serves as a containment isolation valve. Before the design change, Section 10.4.7.1.1 of the SSAR stated that the SFIV serves as a containment isolation valve and closes on a containment isolation signal. Explain why the SFIV should not close on a containment isolation signal. Containment isolation provisions require auxiliary feedwater isolation valves to have remote manually close feature whenever containment isolation is required.

Response:

SSAR subsections 10.4.7.1.1 and 10.4.9.1.1, Revision 6, include a more consistent description of safety related functions of the main and startup feedwater control and isolation valves. Subsection 10.4.7.1.1 discusses only main feedwater system functions and components. Subsection 10.4.9.1.1 discusses only startup feedwater functions and components. Bullet sections of subsection 10.4.9.1.1 are intended to reinforce the first paragraph of the subsection. The design changes to the feedwater system have not modified the safety related logic for automatic isolation of the startup feedwater isolation valves. The startup feedwater isolation valve serves a containment isolation function and closes on an ESF signal indicative of the need to isolate startup feedwater while retaining the defense in depth function of the system. Section 7.3 provides the functional diagrams for closure and subsection 6.2.3 identifies each containment penetration and the ESF signal provided to close the remotely operated containment isolation valves. The valves can also be opened after isolation or closed by a remote manual signal.

SSAR Revision: NONE

Question 410.294

Section 10.4.9 of the SSAR (Revision 4) does not address water hammer problem in the startup feedwater system. Westinghouse added a paragraph in Section 5.4.2.2 of the SSAR (Revision 4) to address the design change by using a separate startup feedwater delivery system connected to the steam generator. However, the information provided in the section regarding water hammer occurrence in the startup feedwater piping is not adequate. Section 5.4.2.2 states, in part, that prevention and mitigation of feedline-related water hammer has been accomplished through an improved design and the layout of the startup feedwater piping includes the same features as the main feedwater line to minimize the potential for water hammer. Provide information on the improved design and design features for water hammer prevention for the startup feedwater system.

Response:

The Main Feedwater Line portion of SSAR Appendix 3B, subsection 3B.2.3, Revision 7, provides a more detailed discussion of the AP600 design features for minimizing water hammer, including piping layout features. The statup feedwater piping layout includes similar features as the main feedwater piping layout, indicated in SSAR subsection 5.4.2.2. These features include: a downward elbow in close proximity to the steam generator startup feedwater nozzle, exclusion of high points limiting void collection, redundant positive isolation to prevent back leakage, and delivery of startup feedwater to steam generator independent of feed rings.

SSAR Revision: NONE

Question 440.354

Re: WCAP-14171 (WCOBRA/TRAC CAD)
Accumulator injection will be followed by injection of the nitrogen pressurizing gas. An issue to be resolved is the successful CMT/in containment reactor water storage tank (IRWST) gravity draining in the presence of the pressurization effect of the cover gas. Identify the applicable assessment data, provide comparisons between the test data and WCOBRA/TRAC calculations to demonstrate the code is capable of correctly modeling CMT/IRWST draining in the presence of nitrogen, and demonstrate the acceptability of the LTC LBLOCA methodology to be used for the evaluation of the AP600 LTC response.

Response:

The long term cooling portion of the AP600 LOCA transients begins when IRWST injection is initiated. This does not occur until after the core makeup tank has drained to its Low-2 level setpoint, which actuates the IRWST isolation valves. During a postulated large break LOCA event, minimal injection of CMT liquid occurs until the accumulator has emptied. The interaction of gas flowing from the empty accumulator with safety injection flow will occur within the initial time frame of the large break LOCA event and will occur with CMT injection, not with IRWST flow delivery.

The WCOBRA/TRAC computation of AP600 core makeup tank draining in the presence of accumulator nitrogen injection involves prediction of similar phenomena to those which occur during the large break LOCA accumulator gas release in conventional plants at a similar time in the transient. During its review by NRC as a large break LOCA code, WCOBRA/TRAC was extensively validated for the prediction of non-condensible gas effects, documentation of which is presented in Reference 440.354-1; the code is shown to predict these effects well for coincident gas and liquid flow into common piping. The application of the same one-dimensional component modeling of non-condensible gas interactions with safety injection flow in the AP600 direct vessel injection line is within the established capability of the code.

WCOBRA/TRAC capability for modeling gravity-driven flows from the core makeup tanks has been validated by prediction of pertinent CMT test facility results (Reference 440.354-2). The range of tests conducted in the CMT test facility includes tests which simulated the delayed draining condition typical of large break LOCA events. Ultimately, any nitrogen injected into the reactor vessel through the DVI line will either flow through the break or make its way to a high point within the reactor coolant system. If it does proceed through the CMT balance line up to the top of the CMT, the gas will enhance the delivery of CMT liquid into the reactor vessel during a large break LOCA event. If it rises to any other high elevation location in the reactor coolant system, it will have no impact on the CMT delivery during the large break LOCA transient. In either case, CMT gravity injection proceeds because the pressure driving force associated with a full CMT is large, and the reactor coolant system is basically at pressure equilibrium once a small amount of accumulator nitrogen is delivered when the tank initially empties of liquid. Overall, the prediction of CMT flow delivery in the presence of accumulator nitrogen in the DVI lines utilizes already validated capabilities of the WCOBRA/TRAC computer code.

References:

440.354-1 Bajorek, S.M. et. al., "Code Qualification Document for Best Estimate Analysis," WCAP-1945-P, Revision 1 (Proprietary), Volume 3, Chapter 16, Section 16-2.

440.354-2 Haberstroh, R.C. et. al. MT01-GSR-003, "WCOBRA/TRAC Core Makeup Tank Preliminary Validation Report," February, 1995.

SSAR Revision: NONE

Question 440.355

Re: WCAP-14171 (WCOBRA/TRAC CAD)
If extended core boiloff occurs, boric acid will accumulate and precipitate interfering with the ability to maintain core cooling. Therefore, subcooled liquid throughput must be demonstrated in the LTC mode that will maintain boric acid concentration within acceptable limits. Please describe the methodology and how it will be used to evaluate this issue; include applicable code/data comparisons demonstrating WCOBRA/TRAC's ability to correctly calculate this LTC mode.

Response:

The long-term cooling pattern established in the AP600 is equivalent to that in conventional Westinghouse plants for a hot leg break location: continuous injection into the cold leg (downcomer injection in AP600) provides a flushing flow through the core and out through the break (ADS stage 4 flow paths in AP600) which precludes concentration of boric acid in the core to a level which might approach the solubility limit. In neither case is boiling necessarily terminated in the core by a specified time, nor is it necessary to create a subcooled fluid condition to achieve effective long term cooling of the core.

Significant, essentially continuous liquid flow through the core was observed in the long-term cooling phase of the tests performed at the Oregon State University test facility. A WCOBRA/TRAC long-term cooling model validated against the OSU long-term cooling test data (Reference 440.355-1) is applied to calculate the long term post-LOCA reactor coolant system and core conditions in AP600. The WCOBRA/TRAC analysis is performed in conjunction with a WGOTHIC code prediction of the AP600 long term containment performance (Reference 440.355-2). WGOTHIC predicts that the AP600 containment sump fluid temperature will ultimately approach saturation during post-LOCA long-term cooling.

References:

440.355-1 LTCT-GSR-003, "WCOBRA/TRAC OSU Long-Term Cooling Preliminary Validation Report," August, 1995.

440.355-2 Revised response to RAI 440.554 (defining the WC/T - WGOTHIC code interface methodology), May, 1996.

SSAR Revision: NONE

Question 471.24

Section 11.5.6 of Chapter 11 of the SSAR states that criticality monitors as required in 10 CFR 70.24 and Regulatory Guide 8.12 are not provided because the design of the fuel pool racks precludes criticality under postulated normal and accident conditions. Justify why criticality monitors are not required and state the requirements that the COL applicant will need to fulfill this requirement.

Response:

Section 70.24 of 10 CFR Part 70 requires a criticality monitoring system for areas containing greater than the specified quantities of special nuclear material. Section 70.24 (c) exempts these requirements for power reactors such as AP600 and Section 70.24 (d) states: "Any licensee who believes that good cause exists why he should be granted an exemption in whole or in part from the requirements of this section may apply to the Commission for such exemption. Such application shall specify his reason for the relief requested." Regulatory Guide 8.12, Section C, Regulatory Position, states: "If ... an evaluation [of the need for criticality alarms in an area] does not determine that a potential for criticality exists, as for example where the quantities or form of special nuclear material make criticality practically impossible or where geometric spacing is used to preclude criticality, such as in some storage spaces for unirradiated nuclear power plant fuel, it is appropriate to request an exemption from section 70.24."

The fuel storage racks for AP600 are designed to prevent criticality under the normal and postulated accident conditions as defined in ANSI/ANS-57.2-1983 and ANSI/ANS-57.3-1983. This includes a criticality analysis of all storage racks such that the multiplication factor, K_{eff}, is less than 0.95 including appropriate uncertainties and biases.

The design of the fuel storage rack is such that it maintains K_{eff} less than 0.95 through the use of geometric spacing and neutron absorbers to limit neutron interaction between fuel assemblies. The K_{eff} limit of 0.95 is not exceeded for all postulated accident conditions, beyond normal storage conditions, based on the double contingency principle of ANSI/ANS-8.1-1983. Therefore, if a criticality analysis has proven that each storage rack design is subcritical, K_{eff} less than 0.95, for possible normal and postulated accident storage configurations, there is no need for a criticality accident alarm system.

The AP600 SSAR includes the information necessary to justify an exemption to 10 CFR 70.24. SSAR sections 9.1.1.3 and 9.1.2.3 provide descriptions of the geometric prevention of criticality for new and spent fuel racks, respectively. SSAR section 9.1.6 includes combined license applicant requirements to confirm criticality calculations for both new and spent fuel racks. SSAR subsection 11.5.6 states that critically monitoring functions are performed by the area radiation monitors in combination with portable bridge monitors.

SSAR Revision: None

Question 952.98

Provide a commitment to submit inservice inspection (ISI) and inservice testing (IST) plans for check valves to include measurements of differential pressure required to initiate flow and the flow required to fully open the tested valve.

Response:

SSAR sections 5.2.4 and 6.6 provide the inservice inspection plans for valves, including check valves. Section 3.9.6 and Table 3.9-16 provide IST plans, including details for the check valves in the passive core cooling system (PXS). The safety related check valves in this system with low differential pressure opening or closing requirements are those in the containment recirculation and IRWST lines. Both sets of valves will be tested for differential pressure required to initiate flow and for full flow. Containment recirculation check valves will be tested mechanically and the IRWST injection check valve by differential pressure methods. Revision 5 of SSAR section 3.9.6 did not revise these requirements and the planned revision of Table 3.9-16 will not include changes to these requirements. Other safety related check valves in PXS (CMT and accumulator discharge) are also included in Table 3.9-16.

SSAR Revision: None

Question 410.276

Re: SSAR Section 9.4.1, Nuclear Island Nonradioactive Ventilation System

Table 9.4.1-1 of the SSAR identifies assumed in-leakages through the Main Control Room (MCR) access doors and the MCR/Technical Support Center (TSC) equipment ductwork (operating) and out leakages through the MCR structure and the through MCR/TSC Heating, Ventilation and Air Conditioning (HVAC) equipment and ductwork (operating). Westinghouse should state that during abnormal operation with high airborne radioactivity conditions, the MCR/TSC HVAC subsystem can limit the doses to the control room operators to General Design Criteria (GDC) 19 dose limits given the assumed in-and out-leakages.

Response:

The "Abnormal Plant Operation" portion of SSAR subsection 9.4.1.2.3.1 (Main Control Room/Technical Support Center HVAC Subsystem), Revision 7, states that the rates shown in Table 9.4.1-1 "maintain operator doses within allowable limits." The GDC 19 portion of SSAR subsection 3.1.2, Revision 7, explicitly states that shielding and HVAC design limit doses in the main control room to less than the required 5 rem whole-body, or its equivalent, during the accident.

SSAR Revision: NONE

Question 410.278

Re: SSAR section 9.4.8, Radwaste Building HVAC System

The Westinghouse should state in Section 9.4.8 of the SSAR that (1) fire dampers are provided at duct penetrations through fire barriers to maintain the fire resistance ratings of the barriers and meet the design and installation requirements of UL-555 (1990), (2) VRS (radwaste building ventilation system) mobile filtration units, including HEPA filters, conforming the guidance of RG 1.140, Positions C.1 and C.2, (3) the supply and exhaust air system ductwork is designed, fabricated and installed to conform with the requirements of Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards, and (4) shielding of components and personnel during normal plant operation is commensurate with radiation sources in the vicinity of the VRS equipment.

Response:

The AP600 SSAR addresses these concerns as follows:

(1) The fire dampers for the radwaste building HVAC system and their applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(2) Mobile filtration units for the radwaste building are the responsibility of the COL holder. Applicable requirements related to Design Certification are contained in the Combined License Information subsections of SSAR Chapter 11 which describe the Radwaste systems.

(3) The ductwork for the radwaste building HVAC system and its applicable codes are described in SSAR subsection 9.4.8.2.2, Revision 7.

(4) The shielding design for the radwaste building is described in SSAR section 12.3.

SSAR Revision: NONE

Question 410.284

Section 9.2.7.2.1 of the SSAR (Revision 3) states that the high capacity subsystem consists of two chilled water pumps, two water-cooled chillers, a chemical feed tank, and an expansion tank. An air separator was eliminated from the previous SSAR revision. However, each of the two loops of the low capacity subsystem still contains of an air separator and other components that are similar to the high capacity subsystem. Explain why the air separator is not required in the high capacity subsystem.

Response:

SSAR subsection 9.2.7.2.1, Revision 6, properly describes the low capacity subsystem without an air separator. Air separators are not required since the expansion tank is sized and located to serve this function.

SSAR Revision: NONE

Question 410.287

Section 9.2.10.3 of the SSAR (Revision 3) states that the hot water heating system (VYS) is a high energy system and has no safety-related function. Provide information regarding the system pressure and temperature and verify that any failure of the VYS piping or equipment will not directly or indirectly result in lose of required redundancy in any portion of the systems or equipment in the safety-related areas. Also, explain why the system was changed to a high-energy system from a moderate-energy system.

Response:

SSAR subsection 9.2.10.3, Revision 6, provides the basis for hot water system's non-safety-related functional status. The specification change from moderate-energy to high-energy was made to ensure its ability to provide hot water under all design conditions.

SSAR Revision: NONE

Question 410.290

Section 9.2.10.5 of the SSAR (Revision 3) states that instruments are provided for monitoring system parameters. Essential system parameters are monitored in the main control room via information taken from the hot water heating system through the plant data display and processing system. What are the essential system parameters related to the hot water heating system. The instruments for the heat exchanger and pumps were initially designed locally on the piping system. Do these instruments provide indication in the control room for the hot water heating system after the design change?

Response:

SSAR subsection 9.2.10, Revision 6, states that the hot water heating system serves no safety-related function and therefore has no nuclear safety design basis. The information provided in the subsection is sufficient for review of the system's potential for impact on the safety of the plant. The subsection also states that instruments are provided for monitoring system parameters and that essential system parameters are monitored in the main control room. Process signals provided by the hot water system instrumentation are communicated to the monitor bus of the data display and processing system. As a result, any of the system instruments can be monitored or displayed in the control room. Local display is also provided as requested by the roving operator on a portable display device. Normal operating display of system parametric data will be developed after Design Certification as part of the man-machine interface, human factors engineering process described in Chapter 18 of the SSAR.

SSAR Revision: NONE

Question 410.292

In Section 10.4.9.2.1 of the SSAR (Revision 4), Westinghouse changed the pump capacity of the startup feedwater system to two 50-percent from two 100-percent pumps. Section 10.4.9.1.2 of the SSAR, Item H, states that two startup feedwater pumps are provided with a single pump capable of satisfying the startup feedwater system flow for decay heat removal. Justify how a single 50-percent capacity pump (with one pump in standby) can satisfy the flow demand and redundancy requirements.

Response:

The Startup Feedwater Pump portion of SSAR subsection 10.4.9.2.2, Revision 6, is consistent with subsection 10.4.9.1.2. Each startup feedwater pump can supply 100 percent of the required flow to the steam generators to meet decay heat requirements.

SSAR Revision: NONE

Question 410.293

Section 10.4.9.1.1 of the SSAR (Revision 4) states, in part, that the startup feedwater control valves (SFCVs) and startup feedwater isolation valves (SFIVs) are designed to close on an appropriate engineered safety signal (startup feedwater isolation signal) and the SFIV also serves as a containment isolation valve. Before the design change, Section 10.4.7.1.1 of the SSAR stated that the SFIV serves as a containment isolation valve and closes on a containment isolation signal. Explain why the SFIV should not close on a containment isolation signal. Containment isolation provisions require auxiliary feedwater isolation valves to have remote manually close feature whenever containment isolation is required.

Response:

SSAR subsections 10.4.7.1.1 and 10.4.9.1.1, Revision 6, include a more consistent description of safety related functions of the main and startup feedwater control and isolation valves. Subsection 10.4.7.1.1 discusses only main feedwater system functions and components. Subsection 10.4.9.1.1 discusses only startup feedwater functions and components. Bullet sections of subsection 10.4.9.1.1 are intended to reinforce the first paragraph of the subsection. The design changes to the feedwater system have not modified the safety related logic for automatic isolation of the startup feedwater isolation valves. The startup feedwater isolation valve serves a containment isolation function and closes on an ESF signal indicative of the need to isolate startup feedwater while retaining the defense in depth function of the system. Section 7.3 provides the functional diagrams for closure and subsection 6.2.3 identifies each containment penetration and the ESF signal provided to close the remotely operated containment isolation valves. The valves can also be opened after isolation or closed by a remote manual signal.

SSAR Revision: NONE

Question 410.294

Section 10.4.9 of the SSAR (Revision 4) does not address water hammer problem in the startup feedwater system. Westinghouse added a paragraph in Section 5.4.2.2 of the SSAR (Revision 4) to address the design change by using a separate startup feedwater delivery system connected to the steam generator. However, the information provided in the section regarding water hammer occurrence in the startup feedwater piping is not adequate. Section 5.4.2.2 states, in part, that prevention and mitigation of feedline-related water hammer has been accomplished through an improved design and the layout of the startup feedwater piping includes the same features as the main feedwater line to minimize the potential for water hammer. Provide information on the improved design and design features for water hammer prevention for the startup feedwater system.

Response:

The Main Feedwater Line portion of SSAR Appendix 3B, subsection 3B.2.3, Revision 7, provides a more detailed discussion of the AP600 design features for minimizing water hammer, including piping layout features. The statup feedwater piping layout includes similar features as the main feedwater piping layout, indicated in SSAR subsection 5.4.2.2. These features include: a downward elbow in close proximity to the steam generator startup feedwater nozzle, exclusion of high points limiting void collection, redundant positive isolation to prevent back leakage, and delivery of startup feedwater to steam generator independent of feed rings.

SSAR Revision: NONE

Question 440.354

Re: WCAP-14171 (WCOBRA/TRAC CAD)
Accumulator injection will be followed by injection of the nitrogen pressurizing gas. An issue to be resolved is the successful CMT/in containment reactor water storage tank (IRWST) gravity draining in the presence of the pressurization effect of the cover gas. Identify the applicable assessment data, provide comparisons between the test data and WCOBRA/TRAC calculations to demonstrate the code is capable of correctly modeling CMT/IRWST draining in the presence of nitrogen, and demonstrate the acceptability of the LTC LBLOCA methodology to be used for the evaluation of the AP600 LTC response.

Response:

The long term cooling portion of the AP600 LOCA transients begins when IRWST injection is initiated. This does not occur until after the core makeup tank has drained to its Low-2 level setpoint, which actuates the IRWST isolation valves. During a postulated large break LOCA event, minimal injection of CMT liquid occurs until the accumulator has emptied. The interaction of gas flowing from the empty accumulator with safety injection flow will occur within the initial time frame of the large break LOCA event and will occur with CMT injection, not with IRWST flow delivery.

The WCOBRA/TRAC computation of AP600 core makeup tank draining in the presence of accumulator nitrogen injection involves prediction of similar phenomena to those which occur during the large break LOCA accumulator gas release in conventional plants at a similar time in the transient. During its review by NRC as a large break LOCA code, WCOBRA/TRAC was extensively validated for the prediction of non-condensible gas effects, documentation of which is presented in Reference 440.354-1; the code is shown to predict these effects well for coincident gas and liquid flow into common piping. The application of the same one-dimensional component modeling of non-condensible gas interactions with safety injection flow in the AP600 direct vessel injection line is within the established capability of the code.

WCOBRA/TRAC capability for modeling gravity-driven flows from the core makeup tanks has been validated by prediction of pertinent CMT test facility results (Reference 440.354-2). The range of tests conducted in the CMT test facility includes tests which simulated the delayed draining condition typical of large break LOCA events. Ultimately, any nitrogen injected into the reactor vessel through the DVI line will either flow through the break or make its way to a high point within the reactor coolant system. If it does proceed through the CMT balance line up to the top of the CMT, the gas will enhance the delivery of CMT liquid into the reactor vessel during a large break LOCA event. If it rises to any other high elevation location in the reactor coolant system, it will have no impact on the CMT delivery during the large break LOCA transient. In either case, CMT gravity injection proceeds because the pressure driving force associated with a full CMT is large, and the reactor coolant system is basically at pressure equilibrium once a small amount of accumulator nitrogen is delivered when the tank initially empties of liquid. Overall, the prediction of CMT flow delivery in the presence of accumulator nitrogen in the DVI lines utilizes already validated capabilities of the WCOBRA/TRAC computer code.

References:

440.354-1 Bajorek, S.M. et. al., "Code Qualification Document for Best Estimate Analysis," WCAP-1945-P, Revision 1 (Proprietary), Volume 3, Chapter 16, Section 16-2.

440.354-2 Haberstroh, R.C. et. al. MT01-GSR-003, "WCOBRA/TRAC Core Makeup Tank Preliminary Validation Report," February, 1995.

SSAR Revision: NONE

Question 440.355

Re: WCAP-14171 (WCOBRA/TRAC CAD)
If extended core boiloff occurs, boric acid will accumulate and precipitate interfering with the ability to maintain core cooling. Therefore, subcooled liquid throughput must be demonstrated in the LTC mode that will maintain boric acid concentration within acceptable limits. Please describe the methodology and how it will be used to evaluate this issue; include applicable code/data comparisons demonstrating WCOBRA/TRAC's ability to correctly calculate this LTC mode.

Response:

The long-term cooling pattern established in the AP600 is equivalent to that in conventional Westinghouse plants for a hot leg break location: continuous injection into the cold leg (downcomer injection in AP600) provides a flushing flow through the core and out through the break (ADS stage 4 flow paths in AP600) which precludes concentration of boric acid in the core to a level which might approach the solubility limit. In neither case is boiling necessarily terminated in the core by a specified time, nor is it necessary to create a subcooled fluid condition to achieve effective long term cooling of the core.

Significant, essentially continuous liquid flow through the core was observed in the long-term cooling phase of the tests performed at the Oregon State University test facility. A WCOBRA/TRAC long-term cooling model validated against the OSU long-term cooling test data (Reference 440.355-1) is applied to calculate the long term post-LOCA reactor coolant system and core conditions in AP600. The WCOBRA/TRAC analysis is performed in conjunction with a WGOTHIC code prediction of the AP600 long term containment performance (Reference 440.355-2). WGOTHIC predicts that the AP600 containment sump fluid temperature will ultimately approach saturation during post-LOCA long-term cooling.

References:

440.355-1 LTCT-GSR-003, "WCOBRA/TRAC OSU Long-Term Cooling Preliminary Validation Report," August, 1995.

440.355-2 Revised response to RAI 440.554 (defining the WC/T - WGOTHIC code interface methodology), May, 1996.

SSAR Revision: NONE

Question 471.24

Section 11.5.6 of Chapter 11 of the SSAR states that criticality monitors as required in 10 CFR 70.24 and Regulatory Guide 8.12 are not provided because the design of the fuel pool racks precludes criticality under postulated normal and accident conditions. Justify why criticality monitors are not required and state the requirements that the COL applicant will need to fulfill this requirement.

Response:

Section 70.24 of 10 CFR Part 70 requires a criticality monitoring system for areas containing greater than the specified quantities of special nuclear material. Section 70.24 (c) exempts these requirements for power reactors such as AP600 and Section 70.24 (d) states: "Any licensee who believes that good cause exists why he should be granted an exemption in whole or in part from the requirements of this section may apply to the Commission for such exemption. Such application shall specify his reason for the relief requested." Regulatory Guide 8.12, Section C, Regulatory Position, states: "If ... an evaluation [of the need for criticality alarms in an area] does not determine that a potential for criticality exists, as for example where the quantities or form of special nuclear material make criticality practically impossible or where geometric spacing is used to preclude criticality, such as in some storage spaces for unirradiated nuclear power plant fuel, it is appropriate to request an exemption from section 70.24."

The fuel storage racks for AP600 are designed to prevent criticality under the normal and postulated accident conditions as defined in ANSI/ANS-57.2-1983 and ANSI/ANS-57.3-1983. This includes a criticality analysis of all storage racks such that the multiplication factor, K_{eff}, is less than 0.95 including appropriate uncertainties and biases.

The design of the fuel storage rack is such that it maintains K_{eff} less than 0.95 through the use of geometric spacing and neutron absorbers to limit neutron interaction between fuel assemblies. The K_{eff} limit of 0.95 is not exceeded for all postulated accident conditions, beyond normal storage conditions, based on the double contingency principle of ANSI/ANS-8.1-1983. Therefore, if a criticality analysis has proven that each storage rack design is subcritical, K_{eff} less than 0.95, for possible normal and postulated accident storage configurations, there is no need for a criticality accident alarm system.

The AP600 SSAR includes the information necessary to justify an exemption to 10 CFR 70.24. SSAR sections 9.1.1.3 and 9.1.2.3 provide descriptions of the geometric prevention of criticality for new and spent fuel racks, respectively. SSAR section 9.1.6 includes combined license applicant requirements to confirm criticality calculations for both new and spent fuel racks. SSAR subsection 11.5.6 states that critically monitoring functions are performed by the area radiation monitors in combination with portable bridge monitors.

SSAR Revision: None

Question 952.98

Provide a commitment to submit inservice inspection (ISI) and inservice testing (IST) plans for check valves to include measurements of differential pressure required to initiate flow and the flow required to fully open the tested valve.

Response:

SSAR sections 5.2.4 and 6.6 provide the inservice inspection plans for valves, including check valves. Section 3.9.6 and Table 3.9-16 provide IST plans, including details for the check valves in the passive core cooling system (PXS). The safety related check valves in this system with low differential pressure opening or closing requirements are those in the containment recirculation and IRWST lines. Both sets of valves will be tested for differential pressure required to initiate flow and for full flow. Containment recirculation check valves will be tested mechanically and the IRWST injection check valve by differential pressure methods. Revision 5 of SSAR section 3.9.6 did not revise these requirements and the planned revision of Table 3.9-16 will not include changes to these requirements. Other safety related check valves in PXS (CMT and accumulator discharge) are also included in Table 3.9-16.

SSAR Revision: None