UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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OCT 30 1984

MEMORANDUM FOR: Thomas M. Novak, Assistant Director for Licensing, Division of Licensing

FROM: L. S. Rubenstein, Assistant Director for Core and Plant Systems, Division of Systems Integration

SUBJECT: SAFETY EVALUATION REPORT INPUT FOR BEAVER VALLEY POWER STATION UNIT 2, AUXILIARY SYSTEMS BRANCH

The enclosed Safety Evaluation Report (SER) input covers those portions of the Beaver Valley Power Station, Unit 2 Final Safety Analysis Report (FSAR) for which the Auxiliary Systems Branch (ASB) has primary responsibility. This evaluation includes the ASB review of all amendments to the FSAR up to and including Amendment 8.

The following areas have not been resolved and require that additional information be provided by the applicant. We will report resolution of these concerns in a supplement to this SER.

1. Section 3.5.1.1 - Internally Generated Missiles(Outside Containment) - The applicant has not provided sufficient information to verify that a single failure was assumed concurrent with postulated internally generated missiles from nonsafety-related sources.

2. Section 3.5.1.2 - Internally Generated Missiles(Inside Containment) - The applicant has not provided sufficient information to verify that a single failure was assumed concurrent with postulated internally generated missiles from nonsafety-related sources.

3. Section 3.6.1 - Protection Against Postulated Pipe Breaks Outside Containment - The applicant's response to our concern regarding means providing protection for safety-related equipment from postulated pipe breaks outside containment is not complete. The applicant has indicated that this information will be provided at a later date.

4. Section 9.1.3 - Fuel Pool Cooling And Cleanup System - The applicant has not demonstrated the capability of the spent fuel pool cooling system to remove the decay heat load from a full spent fuel pool.

5. Section 9.1.5 - Overhead Heavy-Load Handling System - Our review of the applicant's response to the guidelines of NUREG-0612 is not complete. Further, the applicant has not responded to our concern regarding the failure of heavy loads during handling.

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6. Section 9.2.1.2 - Standby Service Water System - The applicant has not adequately addressed the measures taken to prevent fouling and degradation of the standby service water system due to marine growth.

7. Section 9.2.2.1 - Primary Component Cooling Water System - The applicant has not verified that instrumentation provided for indication of loss of component cooling water to the reactor coolant pumps is safety grade.

8. Section 10.4.7 - Condensate And Feedwater System - The applicant shall commit to conduct a water hammer test in accordance with the guidelines of Branch Technical Position ASB 10-2.

9. Section 10.4.9 - Auxiliary Feedwater System - The staff review of the AFW system reliability analysis is not complete.

We plan to provide our safety evaluation report input concerning the post-fire safe shutdown capability (Section 9.5.1, "Fire Protection") to the Chemical Engineering Branch after the applicant has responded to the request for information in this area transmitted to DL by memorandum dated October 15, 1984.

We are also enclosing our SALP evaluation.

L S Rubenstein

L. S. Rubenstein, Assistant Director
for Core and Plant Systems
Division of Systems Integration

Enclosure:
As Stated

cc w/enclosure:
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SALP INPUT

Plant: Beaver Valley Power Station Unit 2

1. Management Involvement and Control in Assuring Quality: Not Applicable

2. Approach to Resolution of Technical Issues from a Safety Standpoint: Category 2

3. Responsiveness to NRC Initiatives: Category 3

4. Enforcement History: Not Applicable

5. Reporting and Analysis of Reportable Events: Not Applicable

6. Staff (Including Management): Not Applicable

7. Training and Qualification Effectiveness: Not Applicable

The following in the narrative for Items 2 and 3 above.

The number of open items and the long time required for the applicant to respond is indictive of the applicant's attitude. The response to a number of our items was simply that information will be provided later. Where the applicant did provide a response, the information was generally acceptable.

To obtain information which was not explicitly stated as needed in the GDC, Regulatory Guides or SRP was difficult and time consuming. Most concerns required several interactions with the applicant to get acceptable information. Discussions often needed to be initiated by the staff. Although some open items have been closed, a number of issues still remain unresolved. Initially the applicant was reluctant to discuss the open items, however, within the last few nonths the applicant has been more cooperative.

SAFETY EVALUATION REPORT
BEAVER VALLEY POWER STATION UNIT 2
AUXILIARY SYSTEMS BRANCH

3.4.1 Flood Protection

The design of the facility for flood protection was reviewed in accordance with Section 3.4.1 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the design of the facility for flood protection with respect to the applicable regulations of 10 CFR 50.

In order to assure conformance with the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," our review of the overall plant flood protection design included systems and components whose failure due to flooding could prevent safe shutdown of the plant or result in uncontrolled release of significant radioacti.ity.

Beaver Valley Power Station Unit 2 is on the same site as Beaver Valley Power Station Unit 1. This site is located in Shippingport Borough on the Ohio River in Beaver County Pennsylvania. The finished grade at the Unit 2 site ranges between 730 feet 4 inches to 735 feet mean sea level (msl) which is equal to or above the maximum external flood calculated for the site. The probable maximum flood (PMF) which results from Ohio River flooding was evaluated by the U.S. Army Corps of Engineers to be 730.0 feet msl in 1970. An analysis of the coincident wind and wave activity during the construction permit review showed the maximum wave height to be 5 feet and the associated wave runup to be 6.7 feet above the standing water level of 730 feet msl. Refer to Section 2.4 of this report for further discussion on the PMF level.

The shared intake structure is the only building housing safety-related equipment which is subject to the effects of coincident waves and associated runup from external flooding. Design basis flood protection for the intake structure assumes the PMF, loss of offsite power, and a concurrent single active failure. The intake structure has four cubicles that house essential pumps and equipment for both Units 1 and 2. These cubicles are located on an operating floor whose elevation is 705 feet msl. To protect the equipment within these cubicles from failure due to the PMF, the four doors to the cubicles and the two sliding flood doors that interconnect adjacent compartments will be closed and sealed. A plant alert will be issued when the Ohio River water level reaches 690 feet msl. The applicant has indicated that the emergency procedure actions will begin when water level reaches 680 feet msl and escalate as the water level rises. Technical specifications will require that flood protection measures be taken for all safety-related systems, components, and structures when the water level of the Ohio River at the intake structure exceeds 695 feet msl which is 10 feet below the elevation of essential equipment. Time is available to take the necessary actions. The above proposed technical specification is the same as that for BVPS-1. This specification is applicable at all times and requires the following protective steps to be taken: as a minimum, achieve hot standby within 6 hours and a cold shutdown within the following 30 hours, as well as close and seal the six cubicle flood doors in the four intake structure cubicles.

The roof of the four pump cubicles is at elevation 730 feet msl. Therefore, to prevent the entry of water, the ventilation air intakes for the cubicles have been raised to elevation 737 feet to allow for the 5 foot maximum wave and the 6.7 foot runup above the standing water level of 730 feet. To further assure that the water tight integrity of the cubicles is maintained, an inflatable seal system is provided at each sliding door. These seals will be tested annually by presurizing them from the dedicated air vessel, and monitoring them for leakage over a period of four days (the duration of the PMF) to verify that the pressure drop is within acceptable limits. The equipment hatches will be gasketed in accordance with the flood protection procedures which are to be initiated once the flow level reaches elevation 695 feet. The cubicle pump shafts are provided with seals which may experience leakage at a rate of a small fraction of a gallon per minute. To remove this water and any other potential water inleakage, each cubicle is provided with a sump pump rated at 65 gpm.

Access to the safety-related equipment at the intake structure is by means of a foot bridge located at elevation 705'-0" or a stairway leading to grade at elevation 675'-0". Both of these approaches will be under water during a PMF. Consequently, the safety-related intake structure is not accessible during a PMF. However, once the cublicles have been prepared for the PMF as described above, the applicant states that no operations are required in the intake structure until the river level drops below elevation 705'-0". We conclude that the above design provisions meet the guidelines of Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants," Positions C.1 and C.2 and Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants," Position C.1.

With the exception of the intake structure, access to all seismic Category I structures is located above grade. As indicated above, access to the intake structure will not be possible during a PMF. All seismic Category I structures which enclose safety-related systems or components in areas at floor levels below elevation 703'-0" have water stops placed in construction joints of the reinforced concrete exterior. These water stops continue to at least elevation 730'-0". Penetrations entering seismic Category I buildings below grade are sealed to prevent inleakage. Further, the applicant indicates that the lowest floor level of all seismic Category I structures is located above the normal ground water level.

To protect the containment from the PMF, a water relief system has been provided consisting of a 6-inch pipe located outside the containment building which extends downward through the 10-foot thick basemat and into the porous concrete sub-base. Should the water level rise, it would activate an alarm in the control room. The water would then be removed by a sump pump in order to prevent the buildup of hydrostatic pressure.

The site storm drainage using catch basins and underground conduits collects and directs surface water and roof runoff to the Ohio River. Thus, the applicant states that flooding of safety-related buildings will not result from the postulated maximum precipitation (PMP). However, the staff is continuing its review of the PMP as discussed further in Section 2.4.2.3 of this report.

To prevent potential internal flooding events outside containment from leading to unacceptable consequences, the following design features are incorporated in the plant:

a. Redundant safety-related components are located in hydraulically separate building areas.

b. Wherever possible, safety-related components are located above the maximum flood level of the building.

c. Safety-related monitoring instrumentation has been provided in building sumps and fluid systems to alert the operator of failures that could lead to flooding conditions.

d. All piping connections between large tanks outside the buildings and the building interiors have been provided with isolation valves to prevent flooding in the event of piping failures within the buildings. In addition, tanks located within safety-related structures have been assumed to fail and flood the building interior, and acceptable consequences have been confirmed. In this regard, the flood protection guidelines of Branch Technical Position ASB 3-1, "Protection Against Piping Failures in Fluid Systems Outside Containment," are satisfied. Refer to Section 9.3.3 of this SER for further discussion of interior flood protection.

Based on the above, we conclude that the facility design is in compliance with General Design Criterion 2 with respect to flood protection and the guidelines of Regulatory Guides 1.102, Position C.1, and 1.59, Positions C.1 and C.2, and Branch Technical Position ASB 3-1, and is therefore acceptable. The design of the facility for providing protection from flooding meets the acceptance criteria of SRP Section 3.4.1.

3.5.1.1 Internally Generated Missiles (Outside Containment)

The design of the facility for providing protection from internally generated missiles outside containment was reviewed in accordance with Section 3.5.1.1 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria except as noted below formed the basis for our evaluation of the design of the facility for providing protection from internally generated missiles outside containment with respect to the applicable regulations of 10 CFR Part 50.

The facility's design adequacy against low trajectory turbine missiles including compliance with the guidelines of Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles," is discussed separately in Section 3.5.1.3.

General Design Criterion 4, "Environmental and Missile Design Bases," requires protection of plant structures, systems, and components, whose failure could lead to offsite radiological consequences or that are required for safe plant shutdown, against postulated missiles associated with plant operation. The missiles considered in this evaluation outside containment include those missiles generated by rotating or pressurized (high-energy fluid system) equipment.

Protection is provided by any one or a combination of compartmentalization, barriers, separation, orientation, and equipment design. The primary means of providing protection to safety-related equipment from damage resulting from internally generated missiles is through the use of plant physical arrangment. Safety-related systems are physically separated from nonsafety-related systems and components of safety-related systems are physically separated from their redundant components. Stored spent fuel in the fuel building is protected by the fuel pool walls from damage by internal missiles which could result in radioactive release and by not locating any high energy piping system or rotating machinery in the vicinity of the fuel. The applicant has identified the safety-related structures, systems, and components (SSC) outside containment that are required for safe shutdown, and has evaluated the potential for internally generated missiles affecting these safety-related SSCs. Pressurized system equipment and rotating components were evaluated as potential missile sources.

The applicant concluded that valves in high pressure systems are not credible sources of missiles due to their compliance with ASME Code Section III criteria, proper stud tightening, hydrostatic testing of the pressure-retaining parts, volumetric and surface testing to verify soundness and critical valve in-service inspections in accordance with ASME Section XI.

Pumps and fans outside of containment were evaluated for the potential of missile generation as a result of a failure or an overspeed condition. Regarding pumps and fans other than the turbine-driven auxiliary feedwater pump, no credible missiles are postulated, as the applicant concluded that the maximum no-load speeds for these pumps and fans are equivalent to the maximum operating speed of the motors. Therefore, a pipe break or single failure could not result in speeds in excess of the no-load condition (no overspeed) and thus no credible missiles are postulated. To prevent the generation of fan blade missiles, the manufacturer's specifications reparding the blade locknut torques and blade tip angle will be followed. To assure that any such missile will be contained, the fan blade will be surrounded by a housing capable of containing the missiles. The applicant will perform an analysis which will demonstrate that potential fan blade missiles will be contained by the fan housings. This approach is acceptable. The turbine-driven auxiliary feedwater pump is located in the safeguards building at elevation 718'-6" within one of the two concrete compartments each housing one of the two redundant motor-driven auxiliary feedwater pumps. Each compartment is designed to contain any missiles generated within the compartment. The orientation of equipment is such as to reduce the possibility of any missile from affecting the motor-driven auxiliary feedwater pumps or other safety-related systems. In addition, a missile barrier has been provided against a potential missile generated by the auxiliary feedwater turbine-driven pump should an overspeed condition occur.

The rod control motor generator sets were evaluated for potential flywheel missile generation. It was concluded that due to material and fabrication standards, nondestructive testing, design stresses as well as the speed and torque limitations on the 1800 RPM induction motor that it was not credible for the motor-generator sets to generate missiles.

In response to our request for information on the location of pressurized containers and the means employed to assure that they will not become a source of internally and externally generated missiles, the applicant indicated that non-ASME Code pressurized tanks and compressed air/gas cylinders with pressures greater than 275 psi are considered credible missiles. Where essential structures, systems, or components are identified in the area of these pressurized containers and no physical separation exists, the missile source will be restrained and/or contained by the supporting structure and shields.

To preclude non safety-related components near components required for safe shutdown from damaging the safe shutdown equipment, the nonsafety-related equipment will be seismically supported.

In regard to the concern that temperature and pressure sensors may become potential missile sources, the applicant stated that temperature sensors are considered a potential source of missiles if the system in which they are installed is a high energy system (pressure greater than 275 psi) and the failure of a single circumferential weld could result in the generation of a missile. However, the applicant's analysis of sensor weld stresses has demonstrated that the designs are conservative and a single weld failure will not cause a missile. Therefore, temperature sensors are not considered credible missile sources. Pressure sensors are not installed directly on system piping, but rather are mounted on other structures with instrument tubing routed to the sensing points on the piping system. Therefore, the applicant concluded that there is no failure mechanism which could result in pressure sensors becoming a missile source.

[However, during our review of the applicant's internally generated missile design analysis, we have been unable to verify that a single failure was assumed concurrent with the postulated internally generated missiles from nonsafety-related sources. It is our position that redundant trains of safety-related systems shall be protected from potential internally generated missiles from nonsafety-related sources as prescribed in SRP Section 3.5.1.1]

[Based on the above, we cannot conclude that the facility design is in conformance with General Design Criterion 4 as it relates to protection against internally generated missiles outside containment. The applicant has not demonstrated that the protection against internally generated missiles outside containment meets the acceptance criteria of SRP Section 3.5.1.1 as indicated above. We will report resolution of our concern in a supplement to this SER.]

3.5.1.2 Internally Generated Missiles (Inside Containment)

The design of the facility for providing protection from internally generated missiles inside containment was reviewed in accordance with Section 3.5.1.2 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the design of the facility for providing protection from internally generated missiles with respect to the applicable regulations of 10 CFR Part 50.

Plant structures, systems and components (SSC) inside containment whose failure could lead to offsite radiological consequences or that are required for safe plant shutdown must be protected against the effects of internally generated missiles in accordance with the requirements of General Design Criterion 4, "Environmental and Missile Design Bases." Potential missiles that could be generated inside containment are from failures of rotating components, pressurized component (high-energy fluid system) failures and gravitational effects.

The applicant's analysis of potential missiles indicates that the catastrophic failure of the reactor vessel, steam generators, pressurizer and reactor coolant pump casings that would lead to the generation of missiles is not considered credible because of the material characteristics, inspections, conservative design, and quality control during fabrication and erection. Nuts and bolts are of negligible concern due to the small amount of energy contained in them.

The potential of the control rod drive mechanism (CRDM) becoming a missile due to a gross failure of the CRDM housing was evaluated. The applicant concluded that the CRDM is not a credible missile source due to their material properties and the conservative design as demonstrated by hydrostatic testing. This analysis also considered the consequences should the CRDM top plug become loose and subsequently ejected. The control rod cluster would travel upward until it impacts the upper support plate. This impact would cause a fracture that would allow the drive shaft to continue accelerating upward until it hit the missile shield, thus preventing it from affecting safety-related equipment.

The applicant's review of the valves within the reactor coolant pressure boundary indicated that there are no credible failures that could lead to missiles because of the conservative design codes, design stresses, surface and volumetric material examinations, and hydrotests to which the valves are subjected.

With regard to those valves that extend above the operating floor such as the relief valves in the region of the pressurizer, bonnet failures were postulated. The analysis showed that any postulated bonnet missiles would be stopped by the pressurizer cubicle walls and roof. Therefore, the containment liner and safety-related equipment would not be affected.

Nonsafety-related components that could fail and potentially affect safety-related components are seismically supported. No missiles generated due to gravitational effects were identified.

In regard to the potential for missiles generated by pressurized tanks and cylinders damaging or degrading those items required for a safe shutdown, the applicant stated that non-ASME Code pressurized tanks and compressed air/gas cylinders with pressures greater than 275 psi are considered credible missiles. Where essential structures, systems, or components are identified in the area of these pressurized containers and no physical separation exists, the missile source will be restrained and/or contained by the supporting structure and shields.

The reactor coolant pump flywheel is not considered a credible source of missiles as discussed in Section 5.4.1 of this report.

In regard to the concern that temperature and pressure sensors may become potential missile sources, the applicant stated that temparture sensors are considered a potential source of missiles if the system in which they are installed is a high energy system (pressure greater than 275 psi) and the failure of a single circumferential weld could result in the generation of a missile. However, the applicant's analysis of sensor weld stresses has demonstrated that the designs are conservative and a single weld failure will not cause a missile. Therefore, temperature sensors are not considered credible missile sources. Pressure sensors are not installed directly on system piping, but rather are mounted on other structures with instrument tubing routed to the sensing point on the piping system. Therefore, the applicant concluded that there is no failure mechanism which could result in pressure sensors becoming a missile source.

To prevent the generation of fan blade missiles, the manufacturer's specifications regarding the blade locknut torque and blade tip angle will be followed. To assure that any such missile will be contained, the fan blade will be surrounded by a housing capable of containing the missiles. The applicant will perform an analysis which will demonstrate that potential fan blade missiles will be contained by the fan housings. This approach is acceptable.

[However, during our review of the applicant's internally generated missile design analysis, we have been unable to verify that a single failure was assumed concurrent with the postulated internally generated missile from nonsafety-related sources. It is our position that redundant trains of safety-related systems shall be protected from potential internally generated missiles from nonsafety-related sources.]

[Based on the above, we cannot conclude that the facility design is in conformance with General Design Criterion 4 as it relates to protection against internally generated missiles inside containment. The applicant has not demonstrated that the protection against internally generated missiles inside containment meets the acceptance criteria of SRP Section 3.5.1.2 as indicated above. We will report resolution of our concern in a supplement to this SER.]

3.5.1.4 Missiles Generated by Natural Phenomena

The tornado missile spectrum was reviewed in accordance with Section 3.5.1.4 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the tornado missile spectrum with respect to the applicable regulations of 10 CFR Part 50.

General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," requires that structures, systems and components essential to safety be designed to withstand the effects of natural phenomena, and General Design Criterion 4, "Environmental and Missile Design Bases," requires that these same plant features be protected against missiles. The missiles generated by natural phenomena that are of concern are those resulting from tornadoes. The site is a tornado region I site as identified in Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants." The missile spectrum is Spectrum II as identified in the SRP. We have evaluated this spectrum and conclude that it is representative of missiles at the site and is, therefore, acceptable. A discussion of the protection afforded safety-related equipment from the identified tornado missiles including compliance with the guidelines of Regulatory Guide 1.117, "Tornado Design Classification," is provided in Section 3.5.2 of this SER. A discussion of the adequacy of barriers and structures designed to withstand the effects of the identified tornado missiles is provided in Section 3.5.3 of this SER.

Based upon our review of the tornado missile spectrum, we conclude that the spectrum was properly selected and meets the requirements of General Design

Criteria 2 and 4 with respect to protection against natural phenomena and missiles and the guidelines of Regulatory Guides 1.76 and 1.117 with respect to identification of missiles generated by natural phenomena and is, therefore, acceptable. We conclude that the tornado missile spectrum meets the acceptance criteria of SRP Section 3.5.1.4.

3.5.2 Structures, Systems, and Components to be Protected from Externally Generated Missiles

The design of the facility for providing protection from tornado-generated missiles was reviewed in accordance with Section 3.5.2 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the design of the facility for providing protection from tornado-generated missiles with respect to the applicable regulations of 10 CFR Part 50.

General Design Criterion 2, "Design Basis for Protection Against Natural Phenomena," requires that all structures, systems, and components important to the safety of the plant be protected from the effects of natural phenomena, and General Design Criterion 4, "Environmental and Missile Design Bases," requires that all structures, systems, and components important to the safety of the plant be protected from the effects of externally generated missiles. The BVPS-2 site's tornado region and tornado missile spectrum are discussed in Section 3.5.1.4 of this SER.

The applicant has identified all safety-related structures, systems, and components requiring protection from externally generated missiles. All safety-related structures are designed to withstand postulated tornado-generated missiles without damage to safety-related equipment. All safety-related systems and components and stored fuel are located within tornado-missile-protected structures or are provided with tornado missile barriers. The ventilation openings in buildings housing essential equipment are protected from tornado missiles by reinforced concrete labyrinths. The onsite emergency diesel generator air intake and exhaust openings are protected by missile barriers. The main steam valve house vent panels are located on the roof of the building and beneath a horizontal concrete missile barrier. The auxiliary feedwater pumps take suction from the primary plant demineralized water storage tank (PPDWST) which is seismically designed and enclosed in a missile- and tornado-protected structure. Buried safety-related systems such as piping and electrical circuits are adequately protected by the overlaying earth. The ultimate heat sink, the Ohio River, has inherent protection against natural phenomena. Thus, the requirements of General Design Criteria 2 and 4 with respect to external missile protection and the guidelines of Regulatory Guides 1.13, "Spent Fuel Storage Facility Design Basis," 1.27, "Ultimate Heat Sink for Nuclear Power Plants," and 1.117, "Tornado Design Classification," concerning tornado missile protection for safety-related structures, systems, and components including stored fuel and the ultimate heat sink are met. Protection from low-trajectory turbine missiles including compliance with Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles," is discussed in Section 3.5.1.3 of this SER.

The supplementary leak collection and release system (SLCRS) is located in the equipment room on the top of the auxiliary building. This area is not protected from missiles generated by natural phenomena. However, the SLCRS is not required to function in order to assure a safe shutdown following a tornado. We therefore conclude that the above design is acceptable.

Based on the above, we conclude that the identified safety-related structures, systems, and components to be protected from externally generated missiles and the provisions in the plant design providing this protection are in accordance with the requirements of General Design Criteria 2 and 4 with respect to missile and environmental effects and the guidelines of Regulatory Guides 1.13, 1.27, and 1.117, concerning protection of safety-related plant features including stored fuel and the ultimate heat sink from tornado missiles and is, therefore, acceptable. The protection provided against externally generated missiles meets the acceptance criteria of SRP Section 3.5.2.

3.6.1 Plant Design for Protection against Postulated Failures in Fluid Systems Outside Containment

The design of the facility for providing protection against postulated piping failures outside containment was reviewed in accordance with Section 3.6.1 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the design of the facility for providing protection against postulated piping failures outside containment with respect to the applicable regulations of 10 CFR 50.

The guidelines for meeting the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," concerning protection against postulated piping failure in high energy and moderate energy fluid systems outside containment are contained in Branch Technical Position ASB 3-1, "Protection Against Postulated Failures in Fluid Systems Outside Containment." The applicant has used the guidance in SRP Section 3.6.1 and Branch Technical Position ASB 3-1 in analyzing the effects of high and moderate energy pipe breaks. The applicant has identified all high and moderate energy piping systems in accordance with the above guidelines and also has identified those systems requiring protection from postulated piping failures.

Regarding the main steam and feedwater system, the main steam and feedwater lines including the isolation valves are located in the main steam and feedwater valve house and steam tunnel and have been classified as part of the break exclusion boundary. The applicant has performed a subcompartment analysis for the main steam and feedwater piping in the valve house to ensure that the resulting jet impingement and environmental effects of the postulated pipe break in one of these lines will not result in adverse consequences. The results of this analysis indicate that the main steam valve house structural integrity is not affected by the pressure increase from the resulting blowdown. [However, the applicant's subcompartment analysis did not consider the effects on the environmental qualification envelop of the superheated steam condition which may result from the postulated steam line break in the valve house or other areas affecting safety-related equipment. The applicant shall provide the results of an analysis which confirms that safety-related equipment affected by the steam line break environment is properly qualified to function. We will report resolution of this concern in a supplement to this SER.]

Thus, we conclude that the requirements of General Design Criterion 4, as they relate to the plant design accommodate the effects of postulated pipe breaks in high energy fluid piping systems outside containment, have been satisfied in this area.

In general, the means used to protect safety-related systems and components throughout the plant are physical separation, enclosure in suitably designed structures, and the use of restraints where separation or enclosures are not feasible. [However, the applicant's analyses for all pipe break locations, including pipe whip, jet impingement, flooding, and environment effects of postulated high and moderate pipe breaks on safety-related equipment and structures in response to our question 410.10 is not complete. The applicant in a letter dated July 2, 1984, has stated that this information will be provided at a later date. Further discussion of the environmental qualification of safety-related equipment is contained in Section 3.11 of this SER. Until receipt of acceptable information as discussed above, we cannot conclude that the applicant has adequately designed and protected areas and systems required for safe plant shutdown following postulated events, including the combination of pipe failure and single active failure.]

[Based on the above, we cannot conclude that the plant design meets the requirements of General Design Criterion 4, and the criteria of Branch Technical Position 3-1 with regard to the protection of safety-related systems and components from postulated high and moderate energy line breaks. The design of the facility for providing protection from high and moderate energy pipe failures and effects outside containment does not meet the acceptance criteria of SRP Section 3.6.1. We will report resolution of our concerns in a supplement to this SER.]

4.6 Functional Design of Reactivity Control Systems

The functional design of the reactivity control systems was reviewed in accordance with Section 4.6 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP sections was performed according to the quidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the functional design of the reactivity control systems with respect to the applicable regulations of 10 CFR 50.

The functional design of the reactivity control systems has been reviewed to confirm that they meet the various reactivity control conditions for all modes of operation. These conditions are the capability to:

(1) Operate in the unrodded, critical, full-power mode throughout plant life;

(2) vary power level from pull power to hot shutdown and ensure control of power distributions within acceptable limits at any power level; and

(3) shut down the reactor in a manner sufficient to mitigate the effects of postulated events discussed in Section 15 of this SER.

The control rod drive system (CRDS), the safety injection system (SIS) and the chemical and volume control system (CVCS) constitute the reactivity control systems.

The CRDS is composed of control rod drive mechanisms (CRDMs) to which the rod cluster control assemblies are attached. The CRDM is a magnetically operated jack. The magnetic jack is an arrangement of three electromagnets that are energized in a controlled sequence to insert or withdraw a given rod cluster control assembly in discrete steps. The rod cluster control assemblies are divided into two categories: control and shutdown.

The control category of rod cluster control assemblies may be automatically inserted or withdrawn to compensate for changes in reactivity associated with power-level changes and power distribution, variations in moderator temperature, or changes in boron concentration. The shutdown category of rod cluster control assemblies, which are fully withdrawn during power operations, are used solely to insert large amounts of negative reactivity to shut down the reactor. Refer to Section 4.3 of this SER for further discussion.

The rod cluster control assemblies are the primary shutdown mechanisms for normal operation, accidents, and transients. They insert automatically upon a reactor trip signal. Concentrated boric acid solution is injected by the SIS in the event of a LOCA, steamline break, or loss of normal feedwater flow, thereby complying with the requirements of General Design Criterion 29, "Protection Against Anticipated Operational Occurences."

The CRDM magnetic jacks are cooled by a forced air cooling system. Cooling is provided by three ventilation subsystems each with two 33 percent capacity fans. The CRDM ventilation system fan draws containment ambient air through the CRDM shroud and then through cooling cores that are cooled by the reactor plant component cooling water system before discharging to the containment, thus limiting the maximum temperature in the magnetic jack coils. The CRDM cooling system is not a safety-related system as its function is not required to assure operability of the CRDMs. However, all the fans are seismic Category I and powered from the emergency buses. The applicant has performed a failure mode and effects analysis which shows that a complete loss of CRDM cooling air may result in a loss of the insulation on the CRDM magnetic jack coils. However, this condition is acceptable as it would result in tripping of the control rods, thus causing a fail-safe condition.

Failure of electrical power to a rod cluster control assembly will result in the insertion of that assembly, as will shearing of the connection between the rod cluster control assembly and control rod drive mechanism. Single failure or a rod cluster control assembly is considered in transient and accident analyses that include the most reactive rod cluster control assembly stuck outside the core. Analysis of accidental withdrawal of a rod cluster control assembly is found to have acceptable results. Thus, the requirements of

General Design Criterion 23, "Protection System Failure Modes," and General Design Criterion 25, "Protection Systems Requirements for Reactivity Control Malfunctions," are satisfied.

The SIS is automatically actuated to inject borated water into the reactor coolant system when a safety injection actuation signal (SIAS) is received. The SIS pumps take suction from the refueling water storage tank (RWST). The SIS is discussed further in Section 6.3 of this SER.

The CVCS is designed to accommodate slow or long-term reactivity changes such as those caused by fuel burnup or by variation in the xenon concentration resulting from changes in reactor power level. The CVCS is used to control reactivity by adjusting the dissolved boron concentration in the reactor coolant system. The boron concentration is controlled (1) to obtain optimum rod cluster control assembly positioning, (2) to compensate for reactivity changes associated with variations in coolant temperature, core burnup, and xenon concentration, and (3) to provide shutdown margin for maintenance and refueling operations or emergencies. A portion of the CVCS (the charging pumps, the boric acid transfer pump discharge, and the boric acid tanks) injects a concentrated boron solution into the reactor coolant system (RCS) to help ensure plant shutdown in the event of an SIAS. The boric acid concentration in the RCS is controlled by the charging and letdown portions of the CVCS.

The CVCS can maintain the reactivity of the reactor within required bounds by means of the automatic makeup system to replace minor leakage without significantly changing the boron concentration in the RCS. Dilution of the RCS boron concentration required for the reactivity losses occurring as a result of fuel depletion may be accomplished by manual action. The CVCS is discussed further in Section 9.3.4 of this SER.

The concentration of boron in the RCS is changed under the following conditions:

(1) startup - boron concentration decreased to compensate for moderator temperature and power increase;

(2) load follow - boron concentration increased or decreased to compensate for xenon transients following load changes;

(3) fuel burnup - boron concentration decreased to compensate for burnup; and

(4) cold shutdown - boron concentration increased to compensate for increased moderator density as a result of cooldown.

Soluble poison concentration is used to control slow operating reactivity changes. If necessary, a rod cluster control assembly movement also can be used to accommodate such changes, but assembly insertion is used mainly to control anticipated operational occurrences even with a single malfunction, such as a stuck rod. In either case, fuel design limits are not exceeded.

The soluble poison control is capable of maintaining the core subcritical under cold shutdown conditions. This conforms to the requirements of General Design Criterion 26, "Reactivity Control System Redundancy and Capability."

The reactivity control systems, including the addition of concentrated boric acid solution by the SIS, are capable of controlling all anticipated operational changes, transients, and accidents. (For further information on performance of the charging and borating portions of the CVCS, refer to Sections 6.3 and 15.3 of this SER.) All accident analyses are performed with the assumption that the most reactive rod cluster control assembly is stuck out and cannot be inserted, which complies with the requirements of General Design Criterion 27, "Combined Reactivity Control System's Capability."

Compliance with the requirements of General Design Criterion 28, "Reactivity Limits," is discussed in Sections 4.3 and 15 of this SER.

Based on the above review, we conclude that the reactivity control system functional design meets the requirements of General Design Criteria 23, 25, 26, 27, 28, and 29 with respect to its fail-safe design, malfunction protection design, redundancy and capability, combined systems capability, reactivity limits, and protection against anticipated operational occurrences and is, therefore, acceptable. The functional design of the reactivity control systems meets the acceptance criteria of SRP Section 4.6.

5.2.5 Detection of Leakage Through Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary leakage detection systems were reviewed in accordance with Section 5.2.5 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the reactor coolant pressure boundary leakage detection systems with respect to the applicable regulations of 10 CFR 50.

A limited amount of leakage is to be expected from components forming the reactor coolant pressure boundary (RCPB). Means are provided for detecting and identifying this leakage in accordance with the requirements of General Design Criterion 30, "Quality of Reactor Coolant Pressure Boundary." Leakage is classified into two types - identified and unidentified. Components such as valve stem packing, pump shaft seals, and flanges are not completely leak-tight. Since this leakage is expected, it is considered identified leakage and is monitored, limited, and separated from other leakage (unidentified) by directing it to closed systems as identified in the guidelines of Position C.1 of Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems."

In the containment building, identified leakage from valve stems, pump seals, reactor vessel flange, and pressurizer relief valves is kept within a closed system by being piped to the primary drains transfer tank or pressurizer relief tank. Flow or temperature devices are provided in the leak-off lines to indicate the source of leakage. The primary drains transfer tank and the pressurizer relief tank are monitored for pressure, temperature, and water level. Leakage collected in these tanks is pumped to the radioactive gaseous waste system or the boron recovery system through flow monitoring devices.

All RCPB leakage in the containment structure which is not collected in the primary drains transfer tank or in the pressurizer relief tank is collected in the unidentified leakage sumps. Unidentified leakage is monitored by seismic Category I, Class 1E sump level instrumentation in both the incore instrumentation sump and containment sump, and by the sump pump run time monitoring system which is capable of detecting a 1-gpm change in the leakage rate into the sump within 1 hour. Indication, alarm, and means to determine leak rate in "gpm" are provided in the control room. Thus, the guidelines of Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems," Position C.2, regarding collection of unidentified leakage and flow monitoring are met.

Unidentified leakage is also detected by containment airborne particulate radioactive monitors and containment gaseous radioactive monitors. These monitors respond to the increase in airborne radioactivity resulting from leakage. Indications and alarms are provided in the control room and operate continuously to detect high activity in the containment. The time to detect reactor coolant leakage by airborne particulate and gaseous radioactive monitors depends upon reactor coolant activity level, location of leakage, leak rate, and background concentration due to previous leakage. The sensitivity of the containment atmosphere radiation monitors is such that leaks of 1 gpm are detected in less than 1 hour. The radiation monitors are seismic Category I and are located in flood and missile protected structures. As a backup, unidentified leakage is also detected by containment pressure, temperature and humidity monitors, which are capable of detecting a 5-gpm leak rate in less than 1 hour under normal operating conditions. Indications and alarms are provided in the control room. Thus, the requirements of General Design Criterion 2, "Protection Against Natural Phenomena," and the guidelines of Regulatory Guides 1.29, "Seismic Design Classification," Positions C.1 and C.2, and 1.45, Positions C.3, C.5, and C.6, regarding methods of unidentified leak detection, sensitivity, and capability to function following an earthquake are satisfied.

For intersystem leakage monitoring, radiation monitors are used to detect reactor coolant leakage into the primary component cooling water system supplying the residual heat removal heat exchangers, letdown heat exchanger, and reactor coolant seal water and thermal barrier heat exchangers. Leakage through steam generator tubes is detected by radiation monitors in the condenser air ejector vent line and by using the sampling system. Safety injection accumulator leakage is detected by level and pressure instruments provided for each accumulator. Further, the periodic sampling of the accumulators and other piping connecting to the RCS is utilized to detect intersystem leakage to the safety injection system. Thus, the guidelines of Regulatory Guide 1.45, Position C.4, regarding intersystem leakage are satisfied.

The applicant has provided indicators and alarms for each leak detection system in the control room as well as provisions for testing and calibration during plant operation. Procedures for converting various indicators to a common leakage equivalent are available to the operators. Thus, the guidelines of Regulatory Guide 1.45, Positions C.7 and C.8, regarding instruments and alarms, and provisions for testing and calibration are satisfied.

The applicant has stated that the plant technical specifications would provide limiting conditions for identified and unidentified leakage, thus satisfying the guidelines of RG 1.45, Position C.9.

The leakage detection systems provided to detect leakage from components of the RCPB furnish reasonable assurance that structural degradation, which may develop in pressure-retaining components of the RCPB, will be detected on a timely basis so that corrective actions can be taken before such degradation could become sufficiently severe to jeopardize the safety of the system, or before the leakage could increase to a level beyond the capability of the makeup system to replenish the loss.

Based on the above, we conclude that RCPB leakage detection systems are diverse and provide reasonable assurance that primary system leakage (both identified and unidentified) will be detected, and meet the requirements of GDC 2 and 30 with respect to protection against natural phenomena and provisions for RCPB leak detection and identification, and the guidelines of Regulatory Guides 1.29, Positions C.1 and C.2, and 1.45, Positions C.1 through C.9, with respect to seismic classification and RCPB leakage detection system design and are, therefore, acceptable.

The detection of leakage through the reactor coolant pressure boundary meets the acceptance criteria of SRP Section 5.2.5.

5.4.11 Pressurizer Relief Tank (Pressurizer Relief Discharge System)

The pressurizer relief discharge system was reviewed in accordance with Section 5.4.11 of the Standard Review Plan (SRP) NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the pressurizer relief discharge system with respect to the applicable regulations of 10 CFR 50.

The pressurizer relief discharge system consists of the pressurizer relief tank, the discharge piping from the pressurizer relief and safety valves, the relief tank internal spray header, the tank nitrogen supply, the vent to containment, and the drain to the liquid radwaste or boron recovery system. The system is nonsafety related (quality Group D, nonseismic Category I) and is not part of the reactor coolant pressure boundary since all of its components are downstream of the reactor coolant system's safety and relief valves. Therefore, its failure would not affect the integrity of the reactor coolant pressure boundary.

The pressurizer relief tank is sized to absorb the energy content of 110% of the full-power pressurizer steam volume through the primary relief and safety valves. Other relief valve discharges to the pressurizer relief tank include those from the residual heat removal system and from the chemical and volume control system. Releases from these sources are less than the design basis release from the pressurizer. The internal spray and bottom drain on the pressurizer relief tank are used to cool the water within the tank. A nitrogen blanket is also provided in the tank to permit expansion of entering steam and to control the tank internal atmosphere. If a discharge exceeding the design basis should occur, the rupture discs on the tank would pass the discharge through the tank to the containment.

The contents of the tank can be drained to the waste holding tank in the liquid radwaste system or the primary drains transfer tank in the boron recovery system via the primary drains transfer pumps. The rupture discs on the pressurizer relief tank have a capacity equal to or greater than the combined capacity of the pressurizer safety valves. The tank and the rupture disc holders are designed for full vacuum to prevent collapse if the contents cool following a discharge without nitrogen being added. The pressurizer relief tank is provided with instrumentation to indicate and alarm high tank pressure, high temperature, and high and low water levels in the control room.

The tank is separated from safety-related equipment so that its failure would not compromise the capability to safely shut down the plant, and further, possible rupture disc fragments do not present a missile hazard should the disc rupture. Thus, the requirements of General Design Criteria 2, "Design Bases for Protection Against Natural Phenomena," and 4, "Environmental and Missile Design Bases," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Positions C.2 are satisfied.

Based on our review, we conclude that the pressurizer relief discharge system meets the requirements of General Design Criteria 2 and 4 with respect to the need for protection against natural phenomena and internal missile protection as its failure does not affect safety system functions, and the guidelines of Regulatory Guide 1.29, Position C.2, concerning its seismic classification, and is, therefore, acceptable. The pressurizer relief tank meets the acceptance criteria of SRP Section 5.4.11.

9 AUXILIARY SYSTEMS

We have reviewed the design of the auxiliary systems necessary for safe reactor operation, shutdown, fuel storage, or whose failure might affect plant safety including their safety-related objectives, as well as the manner in which these objectives are achieved.

The auxiliary systems necessary for safe reactor operation or shutdown include the service water and standby service water systems, primary component cooling water system, ultimate heat sink, heating, ventilation, and air conditioning systems for the control room and areas housing safety-related equipment, auxiliary feedwater system, and essential portions of the main steam and feedwater system.

The auxiliary systems necessary to ensure the safety of the fuel storage facility include new fuel storage, spent fuel storage, spent fuel pool cooling and cleanup system, fuel-handling systems, and heating, ventilation, and air conditioning systems in the fuel and decontamination building.

We have also reviewed other auxiliary systems to verify that their failure will not prevent safe shutdown of the plant or result in unacceptable release of radioactivity to the environment. These systems include the chilled water system, the demineralized water makeup system, potable and sanitary water system, and condensate storage facilities, the turbine plant component cooling water system, the compressed air system, the equipment and floor drainage system, and heating, ventilation, and air conditioning systems for nonessential portions of the auxiliary building, radwaste building, and turbine building.

Aside from the exceptions noted in each applicable section of this SER, BVPS-2 is independent of Unit 1, and, therefore, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," do not apply

9.1.1 New Fuel Storage

The new fuel storage facility was reviewed in accordance with Section 9.1.1 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the new fuel storage facility with respect to the applicable regulations of 10 CFR Part 50.

The acceptance criteria for the new fuel storage facility include compliance with the guidelines of ANS 57.1, "Design Requirements for Light-Water Reactor Fuel Handling System," and ANS 57.3, "Design Requirements for New LWR Storage Facilities," as related to prevention of criticality and radiological design. The guidelines contained in the "Review Procedures" portion of the SRP section were used in lieu of ANS 57.1 and ANS 57.3.

The new fuel storage facility is designed to provide dry storage for new fuel and is located in the seismic Category I fuel and decontamination building adjacent to the spent fuel storage pool. It consists of a vault with a storage capacity for 70 fuel assemblies, i.e., equivalent to one-third core (53 assemblies) plus 17 spare fuel assemblies and is 13'-9" wide, 29'-2" long, and slightly less than 14'-0" deep. The storage racks have been designed to seismic Category I requirements. The individual stainless steel storage cells in the racks are arranged in a 21-inch by 21-inch lattice in a 5 x 14 array.

The seismic Category I fuel and decontamination building is also designed against tornadoes, hurricanes, floods, and external missiles as described in Sections 3.3.1, 3.3.2, 3.4.1, and 3.5.2 of this SER. Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1 are satisfied. Since the new fuel storage facility is not shared with BVPS-1, General Design Criterion 5, "Sharing of Structures, Systems and Components," is not applicable.

The new fuel storage facility is not located in the vicinity of any moderate- or high-energy lines or rotating machinery. Separation from such potential missile sources protects the new fuel from internally generated missiles and the effects of pipe breaks as discussed in Sections 3.5.1.1 and 3.6.1 of this SER.

The new fuel storage facility is designed to store unirradiated, low-emission fuel assemblies. Accidental damage to the new fuel would release relatively minor amounts of radioactivity that would be accommodated by the spent fuel pool area ventilation system. Thus, the requirements of General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control," are satisfied.

The new fuel storage racks when fully loaded are designed so that with fuel of the highest anticipated enrichment and the pool flooded with unborated water, k_{eff} will be 0.95 or less. If the unborated water is replaced by optimum moderation such as foam or water mist, k_{eff} will not exceed 0.98. To prevent the accumulation of liquid in the new fuel storage area, a 4-inch floor drain has been provided. Thus, the requirements of General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling," with regard to criticality during storage are satisfied.

Other than those times when new fuel assemblies are being inserted or withdrawn from the storage facility, the fuel assemblies are protected from damage by a metal decking that covers the entire top of the new fuel storage area. The storage racks can withstand an uplift force equal to the maximum uplift capability of the spent fuel bridge crane and are designed to preclude the inadvertent placement of a fuel assembly in other than the prescribed spacing. Thus, the requirements of General Design Criterion 62 are satisfied with regard to changes in geometry of stored fuel assemblies affecting criticality.

Based on our review, we conclude the new fuel storage facility is in conformance with the requirements of General Design Criteria 2, 61, and 62 as they relate to new fuel protection against natural phenomena, radiation protection and criticality, and the guidelines of Regulatory Guide 1.29, Position C.1, relating to seismic classification, and is, therefore, acceptable. The design of the new fuel storage facility meets the acceptance criteria of SRP Section 9.1.1.

9.1.2 Spent Fuel Storage

The spent fuel storage facility was reviewed in accordance with Section 9.1.2 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria, except as noted below, formed the basis for our evaluation of the spent fuel storage facility with respect to the applicable regulations of 10 CFR Part 50.

The acceptance criteria for the spent fuel storage facility include meeting various portions of the guidelines of ANS 57.2, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations." The guidelines contained in the "Review Procedures" portion of the SRP section were used in lieu of ANS 57.2. Additionally, the acceptance criteria include Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles." However, turbine missiles are evaluated separately in Section 3.5.1.3 of this SER.

The spent fuel storage facility consists of the three following areas: the spent fuel storage pool, the fuel transfer canal, and the fuel cask area. Fuel is capable of being moved between these three areas by the removal of the normally closed gates joining the respective areas using the fuel building motor-driven platform crane.

The maximum storage capacity of the spent fuel storage facility is 1088 PWR type fuel assemblies which is in excess of 17 one-third core refuelings plus one full core discharge. The fuel will be stored in seventeen separate storage racks each with a storage capacity of 64 storage cells.

Criticality analysis demonstrates that the stored fuel is subcritical ($K_{eff} \leq$ 0.95) for all credible combinations of normal and abnormal fuel assemblies/ rack configurations, thus complying with the requirements of General Design

Criterion 62, "Prevention of Criticality in Fuel Storage and Handling," and the guidelines of Position C.1 of Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Bases." All analyses assumed the fuel to be non-irradiated with 3.6 weight percent UO_2 enrichment in a pure water environment. The pool water is normally maintained with a 2,000-ppm boron concentration. The storage racks are stainless steel and utilize a fixed poison consisting of boron carbide in a non-metalic binder placed in vented storage compartments within the racks which serve as a neutron absorber. The minimum center-to-center distance between storage cells in the racks is 10-7/16 inches. Sufficient distance is provided between the free-standing racks to prevent rack collisions during an SSE.

The fuel and decontamination building which houses the spent fuel storage facility is designed to seismic Category I criteria as are the storage racks, pool liners, canals, storage pools, and supporting structures. The building is also designed against tornado missiles and flooding up to elevation 730 feet (refer to Sections 3.4.1 and 3.5.2 of this SER). We conclude that the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Position C.3 of Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Bases," Position C.1 and C.2 of Regulatory Guide 1.29, "Seismic Design Classification," and Position C.3 of Regulatory Guide 1.117, "Tornado Design Classification," are satisfied for the spent fuel storage facility.

The spent fuel storage facility is not located in the vicinity of high-energy lines or rotating machinery. Therefore, physical protection by means of separation is utilized to protect the spent fuel from internally generated missiles and the effects of pipe breaks (refer to Sections 3.5.1.1 and 3.6.1 of this SER). Thus, the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," and the guidelines of Position C.3 of Regulatory Guide 1.13 are satisfied. Since BVPS Units 1 and 2 each have their own fuel and decontamination buildings housing their respective spent fuel storage pools, the storage pools are not shared and General Design Criterion 5, "Sharing of Structures, Systems and Components," is not applicable.

The design of the spent fuel storage racks is such that it is not possible to insert a spent fuel assembly in other than a design location. The racks can withstand the impact of a dropped fuel assembly without unacceptable damage to the fuel, and the storage racks are protected against excessive uplift forces during fuel handling by the motor-driven platform crane hoist load cell.

The spent fuel pool area ventilation system is designed to limit the potential release of radioactivity in the event of a fuel handling accident (see Section 9.4.2 of this SER for a discussion of the spent fuel pool area ventilation system) in accordance with the guidelines of Position C.4 of Regulatory Guide 1.13. Thus, the spent fuel storage facility complies with the requirements of General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."

Control room and local alarms are provided to alert the operator to high and low pool water level, and high temperature in the fuel pool. The fuel handling building also has a radiation monitoring system. These features satisfy the requirements of General Design Criterion 63, "Monitoring Fuel and Waste Storage."

Based on our review, we conclude that the spent fuel storage facility is in conformance with the requirements of General Design Criteria 2, 4, 61, 62, and 63 as they relate to protection of spent fuel against natural phenomena, missiles, radiation protection, prevention of criticality, and performance monitoring, and the guidelines of Regulatory Guides 1.14, Positions C.1, C.3, and C.4, 1.29, Positions C.1 and C.2, and 1.117, Position C.3, relating to the facility's design, seismic classification, and protection against tornado missiles, and is, therefore, acceptable. We conclude that the spent fuel storage facility meets the acceptance criteria of SRP Section 9.1.2.

9.1.3 Fuel Pool Cooling and Cleanup System

The fuel pool cooling and cleanup system was reviewed in accordance with Section 9.1.3 of the Standard Review Plan (SRP), NUREG-0800. As audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the fuel pool cooling and cleanup system with respect to the applicable regulations of 10 CFR 50.

The fuel pool cooling and cleanup system is designed to maintain water quality and clarity of the fuel pool, refueling cavity and refueling water storage tank, and to remove decay heat generated by spent fuel assemblies in the fuel pool. The system includes all components and piping from inlet to exit from the spent fuel pool and refueling cavity, piping used for normal pool makeup from the primary grade water system, and the cleanup filter/demineralizers to the point of discharge to the radwaste system. The fuel pool cooling system consists of two "maximum normal heat-load" full-capacity fuel pool cooling pumps and two pool coolers with associated piping and valves. Cooling for the fuel pool heat exchangers is provided by the reactor plant component cooling water system (see SER Section 9.2.2 for details). The cooling pumps and heat exchangers are cross connected such that either pump can be used with either or both heat exchangers. The pumps can be powered from the Class 1E emergency sources. The fuel pool cleanup system consists of two parallel pumps, two parallel filters, and one mixed bed fuel pool ion exchanger. During normal operation, one cleanup pump is operating and the other pump is on standby.

The fuel pool cooling and cleanup system is housed in the seismic Category I, flood- and tornado-protected fuel and decontamination building and containment (refer to Sections 3.4.1 and 3.5.2 of this SER) which are also capable of withstanding the effects of external missiles. The cooling system is completely separate from the cleanup system. The cooling system is designed to quality Group C and seismic Category I requirements, as is the reactor plant component cooling water system. The cleanup system piping, valves, and filters comply with quality Group D and nonseismic requirements. Its failure will not affect safety-related equipment. Thus, the requirements of General Design Criteria 2, "Design Bases for Protection Against Natural Phenomena," and 4, "Environmental and Missile Design Bases," and the guidelines of Regulatory Guides 1.13, Positions C.1 and C.2, "Spent Fuel Storage Facility Design Bases," 1.26, Position C.2, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," and 1.29, Positions C.1 and C.2, "Seismic Design Classification," are satisfied.

The BVPS-2 spent fuel pool cooling and cleanup system is not shared with BVPS-1, thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable.

Provisions have been made for routine visual inspection of the fuel pool cooling system components and instruments. The cooling pumps are normally operating and thus periodic testing is not required. Therefore, the requirements of General Design Criteria 45, "Inspection of Cooling Water System," and 46, "Testing of Cooling Water System," are satisfied.

[The applicant stated that the fuel pool heat loads have been calculated in accordance with Branch Technical Position ASB 9-2. The applicant further stated that under the "maximum normal heat-load" (defined below), the pool temperature would be maintained below 140°F assuming the failure of one cooling train. This heat load has been identified by the applicant as being based on one-third core after 150 hours of decay, one-third core with one year of decay plus one-third core with 400 days' decay. We consider the "maximum normal heat-load" to be that which would exist when the pool is completely filled with successive normal refueling batch discharges. We will require the applicant to demonstrate that the spent fuel pool cooling system is capable of maintaining the pool water temperature at or below 140°F when the storage pool is completely filled with normal discharges, assuming that one cooling train has failed.]

[The "maximum abnormal heat-load" has been identified by the applicant as one full core discharge with 150 hours of decay plus one third core discharge with 36 days' decay, and one third core with 400 days' decay. With this heat load, the applicant stated that the pool temperature is maintained at or below 165°F. We consider the "maximum abnormal heat-load" as one full core discharge plus all other fuel storage cells in the storage pool filled with successive normal refueling batch discharges. We will require the applicant to demonstrate that the spent fuel pool cooling system is capable of maintaining the pool water temperature below boiling when the pool contains a full core discharge and all other storage spaces are filled with normal discharges. We therefore cannot conclude that the requirements of General Design Criterion 44, "Cooling Water," are satisfied.]

No connections are provided to the spent fuel pool that may cause the pool water to be lowered below 10 feet above the top of the stored fuel, thereby assuring adequate shielding for the fuel. The design does not allow any piping to terminate below this elevation, and, therefore, the water level in the pool cannot be decreased below the top of the fuel stored in the spent fuel storage racks. Normal makeup to the fuel pool is provided from the primary grade water system (see SER Section 9.2.8). The seismic Category I service water system serves as a backup water supply. An additional emergency source of makeup water is available from the fire protection system. In order to prevent contamination of the pool water during normal operation, a spool piece must be installed when utilizing the service water line. Blind flanges are normally installed at the connections to the service water system. Thus, the requirements of General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control," and the guidelines of Regulatory Guide 1.13, concerning fuel pool design are satisfied.

The system incorporates control room alarmed pool water high and low level, pool water high temperature, cooling pump low discharge pressure, fuel pool cooling pump auto trip, refueling cavity water low level, and building radiation level monitoring systems, thus satisfying the requirements of General Design Criterion 63, "Monitoring Fuel and Waste Storage."

[Based on our review, except as noted above, we conclude that the spent fuel pool cooling and cleanup system is in conformance with the requirements of General Design Criteria 2, 4, 44, 45, 46, 61, and 63, and the guidelines of Regulatory Guides 1.13, 1.26, 1.29 and BTP ASB 9-2 with respect to protection against natural phenomena, missiles, inservice inspection, functional testing, radiation protection, performance monitoring, system design, quality group, and seismic classification. The spent fuel pool cooling system meets the acceptance criteria of SRP Section 9.1.3 except as noted. We will report resolution of our concerns in a supplement to this SER.]

9.1.4 Light Load Handling System (Related to Refueling)

The light load handling system was reviewed in accordance with Section 9.1.4 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the fuel handling system with respect to the applicable regulations of 10 CFR 50.

Any load of a weight less than one fuel assembly and its associated handling tool is defined as a light-load. The light-load-handling system is related to refueling and consists of all components and equipment used in handling new fuel from the receiving station to the loading of spent fuel into the shipping cask. The system includes the equipment designed to facilitate the periodic refueling of the reactor and incudes the manipulator crane, motor-driven platform crane, fuel elevator, the fuel transfer system, rod cluster control changing fixture and associated handling tools and devices. The handling of fuel during refueling is controlled by a series of interlocks to ensure that fuel handling procedures are maintained. The design ensures that no failure will result in release of radioactivity in excess of that assumed in the design basis fuel handling accident.

The manipulator crane is a rectilinear bridge and trolley system with a vertical mast extending down into the water. The machine is used to handle new and spent fuel assemblies within the reactor vessel and refueling cavity inside of containment. Electrical interlocks and limit switches on the bridge, trolley and hoise drives prevent damage to the fuel assemblies. Redundant limit switches on the mast winch prevent a fuel assembly from being raised above a safe shielding water depth. The main hoist is provided with two independent and diverse braking systems each rated at 125 percent of the hoists design load to prevent the dropping of a load due to loss of power.

The motor driven platform crane is a gantry type, multiple grider traveling crane that operates over the spent fuel pool, spent fuel cask loading area, fuel transfer canal, new fuel storage and new fuel receiving area. It is primarily used for handling new and spent fuel assemblies within the fuel and decontamination building.

The new fuel elevator is used to lower new fuel assemblies (one at a time) to the bottom of the fuel storage area where they can be transported by the motor driven platform crane.

The fuel transfer system includes an underwater electric motor drive transfer car that transports fuel assemblies between the refueling cavity and the refueling canal. It runs on tracks extending from the refueling cavity through the transfer tube and into the refueling canal. Fuel assemblies are placed on the transfer car within the refueling cavity by the manipulator crane. The transfer car then passes through the transfer tube and into the refueling canal where the fuel assembly is removed by the motor driven platform crane. The operations are in the reverse order when fuel assemblies are moved from the fuel and decontamination building to the refueling cavity inside the containment structure.

The entire system is housed within the fuel and decontamination building and the containment, which are seismic Category I, flood and tornado protected structures (see to Sections 3.4.1 and 3.5.2 of this SER). Although fuel handling system components are not required to function after an SSE, critical components of the fuel handling system are designed to seismic Category I requirements so that they will not fail in a manner that results in unacceptable consequences such as fuel damage or damage to safety-related equipment. The motor-driven platform crane is seismically designed, and meets the guidelines of Crane Manufacturers Association of America, Inc. Specification CMAA 70 and ANSI B 30.2 "Overhead and Gentry Cranes." In this regard, the design satisifies the requirements of General Design Criterion 2 "Design Basis for Protection Against Natural Phenomena" and the guidelines of Regulatory Guide 1.29, "Seismic Classification" Position C.2, and ANS 57.1, "Design Requirements for LWR Fuel Handling Systems."

The BVPS-2 fuel handling system is not shared with BVPS-1. Therefore, the requirements of General Design Criterion 5 are not applicable.

The applicant has performed an analysis of the potential consequences resulting from dropping of light loads (those that weight less than a fuel assembly plus handling fixture) over the spent fuel pool or reactor vessel in order to verify that any radiological releases are within those assumed for the design basis fuel handling accident. This analysis has shown that certain tools handled above stored spent fuel can develop kinetic energy greater than that of a dropped fuel assembly. Consequently, the applicant has committed to perform additional analyses to establish if the storage rack can adequately protect the stored spent fuel from the above postulated load drops. Should this protection not be determined to be sufficient, the applicant has committed to limit the height to which these loads are lifted such that the kinetic energy from the postulated drop will be less than that of a dropped fuel assembly. We find the above commitments acceptable for assuring that dropping of light loads will not result in kinetic energy or associated fuel damage in excess of that assumed in the design basis fuel handling accident. Thus, we conclude that the requirements of General Design Criteria 61 "Fuel Storage and Handling and Radioactivity Control" and 62 "Prevention of Criticality in Fuel Storage and Handling" and the guidelines of Regulatory Guide 1.13, "Fuel Storage Facility Design Basis" Positions C.1, C.3, C.5 and C.6 are satisfied.

Based on our review, we conclude that the light load handling system is in conformance with the requirements of General Design Criteria 2, 61, and 62 as they relate to protection against natural phenomena, and safe fuel handling including prevention of radiological release and criticality, and the guidelines of Regulatory Guides 1.13, Positions C.1, C.3, C.5, and C.6, and 1.29, Position C.2 with respect to overhead crane design, prevention of unacceptable releases in fuel handling accidents, and maintaining the plant in a safe condition following a seismic event. The light load handling system is also in conformance with the applicable guidelines of ANSI/ANS 57.1, and is, therefore acceptable. The light load fuel handling system meets the acceptance criteria of SRP Section 9.1.4.

9.1.5 Overhead Heavy Load Handling System

The overhead heavy load handling systems were reviewed in accordance with Section 9.1.5 of the Standard Review Plan, NUREG-0800. An audit of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria, except as noted below, formed the basis for our valuation of the overhead heavy load handling system with respect to the applicable regulations of 10 CFR 50.

The acceptance criteria for the overhead heavy loadhandling system include meeting the guidelines of ANSI/ANS 57.1 and 57.2. The guidelines contained in the "Review Procedures" in NUREG-0800 and NUREG-0612 were used instead of ANSI/ANS 57.1 and ANSI/ANS 57.2.

The overhead heavy load handling system consists of components and equipment used to move loads weighing more than one fuel assembly and its associated handling device. The equipment includes the containment polar crane and cask handling crane which handle heavy loads such as the reactor vessel head, reactor internals, shield plug segments, and spent fuel cask. The containment polar crane is not used for handling fuel assemblies. The spent fuel cask handling crane does, however, handle fuel assemblies.

The overhead heavy load handling system is housed within the seismic Category I, flood and tornado protected containment, fuel and decontamination building, auxiliary building and intake structure (refer to Sections 3.4.1 and 3.5.2 of this SER). The containment polar crane and the cask handling crane are designed to seismic Category I criteria so that they will not fail in a manner which results in unacceptable consequences such as fuel damage or damage to safety-related equipment. However, the cranes are not required to function following an SSE. Therefore, the design satisfies the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guides 1.13, "Spent Fuel Storage Facility Design Bases," Positions C.1, and C.6, and 1.29, "Seismic Design Classifications," Position C.2.

Since BVPS-2 has its own overhead heavy load handling system, the requirements of General Design Criterion 5, "Sharing of Structures, Systems, and Components," are not applicable.

The main hoist of the spent fuel cask-handling crane is prevented from traveling over the spent fuel pool by mechanical stops. The spent fuel cask is brought to the cask storage area along a prescribed path and enters the storage area without passing over spent fuel in the pool. The cask is not lifted to an elevation above any structural surface high enough to cause damage that could result in unacceptable radiological release should the cask be dropped. No safety-related equipment is located along the path of travel of the cask. The walls that surround the cask loading area rise to the same height as the other pool walls and are structurally designed to withstand the impact force resulting from a falling cask. Should the cask tip after falling on the guard walls surrounding the cask loading area, its center of gravity is such that it will not fall outside the cask load area and will not affect the fuel in the spent fuel storage pool. A dropped cask cannot, therefore, result in fuel damage in excess of that assumed in the design basis fuel handling accident, or damage safety-related equipment. Thus, the requirements of General Design Criteria 4 "Environmental and Missile Design Bases" and 61 "Fuel Storage and Handling and Radioactivity Control" and the guidelines of RG 1.13, positions C.3 and C.5 are satisfied for handling of the spent fuel cask.

Additional criteria regarding the safe handling of heavy loads is contained in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." NUREG-0612 was transmitted to the applicant for action by NRC generic letters dated December 22, 1980, and February 3, 1981. NUREG-0612 resolved Generic Task A-36 and provides guidelines for necessary changes to ensure safe handling of heavy loads once the plant becomes operational. Enclosure 2 attached to the December 22, 1980, generic letter identified a number of interim measures dealing with safe load paths, procedures, operator training, and crane inspections, testing, and maintenance. The applicant has committed to implement these interim measures before receiving an operating license. [However, our review of the applicants response to the guidelines of Section 5.5.1 of NUREG-0612 (Phase I, 6-month response to the NRC generic letter dated December 22, 1980) and Sections 5.1.2 through 5.1.6 (Phase II, 9-month response to the NRC generic letter dated December 22, 1980) is not complete. Further, the applicant has not yet responded to our concern regarding the failure of heavy loads during handing. We will report resolution of these items in a supplement to this SER.]

[Based on our review, we conclude that the overhead heavy load handling system is in conformance with the requirements of GDC 2, 4, and 61 as they relate to its protection against natural phenomena, missile protection, safe handling of the spent fuel cask, and the guidelines of RGs 1.13, Positions C.1, C.3, C.5, and C.6, and 1.29, Positions C.1 and C.2, with respect to overhead crane interlocks and maintaining plant safety in a seismic event. The system, therefore, is acceptable, except as noted above with respect to NUREG-0612 issues. The overhead heavy load handling system meets the acceptance criteria of SRP Section 9.1.5, except as noted above. We will report resolution of this item in a supplement to this SER.]

9.2.1 Service Water and Standby Service Water Systems

9.2.1.1 Service Water System

The service water system was reviewed in accordance with Section 9.2.1 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of these areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the service water system with respect to the applicable regulations of 10 CFR Part 50.

The service water system (SWS) performs both safety and nonsafety functions by supplying cooling water to the plant from the ultimate heat sink, the Ohio River. The ultimate heat sink is discussed in detail in Section 9.2.5 of this SER.

The SWS for Beaver Valley Unit 2 consists of two trains each with one SWS pump and an additional standby (swing) pump capable of being aligned to either of the two trains. Equipment in each of the two trains is powered from separate redundant emergency Class IE buses and the standby pump is capable of being powered from either emergency bus.

The SWS provides cooling for both normal and accident conditions. During normal operation (including normal shutdown) the SWS cools the primary and secondary component cooling water (CCW) heat exchangers, charging pump lube oil coolers, control room air-conditioning (A/C) refrigerant condenser, centrifugal water chiller condensers, safeguard air-conditioning units, main steam and feedwater valve house cooling coils, motor control center cooling coils and the alternate shutdown panel air-conditioning unit. During a design basis accident, the SWS cools the recirculation spray coolers, charging pump lube oil cooler, control room air-conditioning refrigerant condenser or air-conditioning unit, emergency diesel generator cooling system heat exchanger, motor control center cooling coils, rod control area air conditioning unit, safeguards area air-conditioning unit and main steam and feedwater valve house cooling coils. The SWS provides an emergency source of makeup water to the fuel pool, and an emergency back-up source of water to the auxiliary feedwater system. The SWS also provides cooling to the containment recirculation coolers in the event of loss of the nonsafety-related chilled water system (refer to Section 9.2.2.2 for further discussion.)

Two of the three SWS pumps are required for normal operation while only one is required for safe shutdown. Therefore each pump is considered to be 50 percent capacity during normal operation and is considered to be 100 percent capacity during shutdown operations and emergency conditions.

Each train of the SWS consists of one SWS pump, a service water self-cleaning traveling screen, two booster pumps, piping and valves. The booster pumps provide the additional head required by the control room A/C condenser. The SWS discharge from the containment recirculation coolers and primary CCW head exchangers contain radiation monitors and the SWS can be manually isolated to prevent leakage to the environment on receipt of a high radiation alarm.

The SWS pumps are each located individually in three of the four separate pump cubicles in the seismic Category I intake structure. The intake structure cubicles are flood protected to el 737 ft msl by the use of compartment doors. Further, the ventilation air intakes for these cubicles are at least above the flood elevation. Net positive suction head will be maintained at the suction of the pumps due to their location at el 640 ft 7 inches which is 8 feet below low river water level. The SWS discharges into the Ohio River through the emergency outfall structure and to the circulating water system. Chlorine injection is used to inhibit the growth of algae and other aquatic organisms. Chlorinated water injection is supplied through diffusers in the valve pit. The applicant states that this will be accomplished by utilizing chorinated water supplied by BVPS-1. The procedures and operating practices will be similar to that of BVPS-1. The applicant indicates that the present procedures and operating practices at BVPS-1 including testing, inspections and trending programs have been successful in detecting system degradation due to marine fouling.

All safety-related components of the SWS are housed in seismic Category I, flood and tornado protected structures. Underground piping of the SWS is also protected from these natural phenomena. The system itself is designed to seismic Category I, Quality Group C requirements with the exception of the lines providing cooling to nonsafety related components and the discharge to the circulating water system. Redundant seismic Category I, Class IE powered motor operated isolation valves are provided between safety-related and nonsafety-related portions of the system. These valves close automatically on receipt of a containment isolation signal or SWS low pressure such as would occur in the event of failure of the nonsafety-related portion. A seismic Category I restricting orifice is provided in the SWS discharge line to the circulating water system. The orifice will prevent loss of SWS function in the event of failure of the nonseismic Category I downstream piping by limiting the flow from any postulated break. Manual valves are provided in the SWS line to isolate the safety-related from the nonsafety-related portion. Flooding of safety-related equipment will not occur as the water will enter the turbine building and yard. Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena" and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification" Position C.1 and C.2 are satisfied.

The SWS is designed to meet the single failure criterion. Power is supplied to redundant SWS pumps from separate emergency buses. Each service water pump can supply the minimum cooling water requirements during a design basis accident (DBA) with loss of offsite power and during cold shutdown with the loss of offsite power. Therefore, we conclude that the requirements of General Design Criterion 44, "Cooling Water" are satisfied.

The SWS is not shared with BVPS-1 except for the ultimate head sink and intake structure. Therefore, we conclude that the requirements of General Design Criterion 5," Sharing of Structures, Systems and Components" are not applicable.

The SWS will be periodically tested and inspected in accordance with technical specifications. Preoperational tests will also be performed. The major portion of the SWS including the SWS pumps are in continual use and therefore do not require periodic testing. However, the motor operated valves in the lines to and from the recirculation spray coolers which are not normally operated will be tested periodically to ensure satisfactory operation. A program for detection of potential biological fouling problems has also been established as discussed above. Therefore, we conclude that the requirements of General Design Criteria 45, "Inspection of Cooling Water System" and 46, "Testing of Cooling Water System" are satisfied.

Based on the above, we conclude that the SWS meets the requirements of General Design Criteria 2, 44, 45 and 46 with respect to the system's protection against natural phenomena, capability for transferring the required heat loads, inservice inspection, and testing and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2, with respect to the system's seismic classification, and is therefore, acceptable. The SWS meets the acceptance criteria of SRP Section 9.2.1.

9.2.1.2 Standby Service Water System

The standby service water system (SSWS) provides emergency shutdown cooling capabilities in the eventuality that the seismic Category I primary intake structure has been disabled by a postulated event such as a gasoline barge impact/explosion. This system is designed to accommodate unit shutdown from a scram at 100 percent reactor power and subsequent cooldown of the reactor coolant system after the postulated loss of the intake structure. Therefore, it provides a cooling water function comparable to that of the SWS during postulated site related events. The SSWS is designed to nonsafety related system criteria but can withstand a single active failure concurrent with a loss of offsite power. The SSWS is located so as to preclude damage from gasoline barge impact/explosion that may disable the intake structure. Thus, the requirements of General Design Criterion 44 are satisfied.

The SSWS consists of two 100-percent capacity pumps capable of being powered from redundant emergency Class IE power sources which connect to redundant seismic Category I service water supply lines via normally closed seismic Category I motor-operated valves located in a seismic Category I valve pit. From this connection the cooling water flows through the service water system lines. The service water system lines have seismic Category I check valves, located in the valve pit, which will isolate the SSWS from the disabled intake structure during a design basis event. This feature enables the SWS to continue unit shutdown cooling when it is supplied by the SSWS. Thus, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29 Position C.2 are satisfied.

The SSWS pumps for BVPS-2 share the auxiliary intake structure with the auxiliary river water pumps for BVPS-1 but are housed in a separate bay. The BVPS-2 SSWS does not serve BVPS-1, thus the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable.

[The applicant has not satisfactorily addressed the measures (e.g., design and procedures) that will be taken to prevent fouling and degradation of the SSWS as a result of marine growth nor has the applicant confirmed that periodic SSWS testing and inspection will be assured by technical specifications. Thus, the requirements of General Design Criteria 45 and 46 are not satisfied.]

[Based on the above, except as noted, we conclude that the SSWS adequately ensures a sufficient supply of service water to accomplish unit shutdown and subsequent cooldown in the event the SWS seismic Category I intake structure is lost due to a gasoline barge impact/explosion. We cannot confirm that the requirements of General Design Criteria 45 and 46 concerning testing and inspection until resolution of our biofouling concern. The SSWS meets the requirements of General Design Criteria 2 and 44, and the guidelines of Regulatory Guide 1.29, Position C.2. We will report resolution of our concern in a supplement to this SER.]

9.2.2 Cooling Systems for Reactor Auxiliaries (Reactor Auxiliary Cooling Water System)

The cooling systems for reactor auxiliaries were reviewed in accordance with Section 9.2.2 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the cooling systems for reactor auxiliaries with respect to the applicable regulations of 10 CFR 50.

The cooling systems for reactor auxiliaries consists of the primary component cooling water, chilled water, and neutron shield tank cooling water systems. These systems are used individually or in combination to provide cooling water for heat removal from reactor plant components.

9.2.2.1 Primary Component Cooling Water System

The primary component cooling water (PCCW) system is a closed loop cooling water system that transfers heat from reactor auxiliaries to the service water system during power operation and during normal and emergency shutdown. It provides an intermediate barrier between radioactive or potentially radioactive heat sources and the service water system.

The PCCW system includes three motor driven cooling water pumps, three heat exchangers, two surge tanks, a chemical addition tank and associated piping and valves. Each pump and heat exchanger is rated at 50 percent capacity during normal plant operation with the service water temperature at its maximum. The system is designed to reduce the reactor coolant temperature from 350°F to 150°F in 20 hours with service water available at 86°F.

The system provides cooling water to the safety-related seal water heat exchangers, fuel pool coolers, RHR heat exchangers and RHR pump seal coolers, reactor coolant pump thermal barriers and bearing oil coolers, excess letdown heat exchangers, CRDM shroud cooling coils, and neutron shield tank cooler. It also provides cooling water to nonsafety-related components such as the radioactive liquid and gaseous water system, chilled water system refrigeration units, containment penetration coolers, reactor plant sampling system and auxiliary condensate system cooler.

All safety-related portions of the PCCW system are located inside seismic Category I, tornado, missile, and flood protected buildings. Safety-related piping and equipment are designed to seismic Category I and quality group C requirements. The nonsafety-related portion is isolated automatically by redundant valves on a containment isolation Phase A (CIA) signal or low surge tank water level signal. Thus, failure of the nonsafety-related portion of the system will not affect the performance or reliability of the safety-related components. Therefore, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Positions C.1 and C.2 are satisfied.

No portion of the PCCW is shared with Beaver Valley Unit 1. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable.

The system is designed to meet the single failure criterion with two redundant trains to serve those components essential for safe shutdown. During normal operation, two PCCW pumps and two heat exchangers accommodate the plant heat loads. A spare pump and heat exchanger is provided to allow for RPCCW pump or heat exchanger maintenance. One PCCW pump is powered from one emergency bus and the second pump is powered from the redundant emergency bus. The spare pump can be manually connected to either emergency bus. During accident conditions, one pump and one heat exchanger train is sufficient to accommodate the heat removal load. The water level in the two surge tanks is automatically maintained by air-operated valves admitting makeup water from the demineralized water system. Thus, the requirements of General Design Criterion 44, "Cooling Water" are satisified.

In response to our concern regarding loss of component cooling water flow to the reactor coolant pumps (RCPs) as a result of a single failure in the common supply line which might result in the occurrence of an unacceptable locked rotor condition, the applicant has indicated that the RCPs can function satisfactorily for 10 minutes without component cooling water flow. Low component cooling water flow alarms are provided in the control room to indicate a loss of component cooling water supply. This allows the operator sufficient time to trip the pumps before unacceptable damage could occur. Redundant high oil cooler temperature alarms and high bearing temperature alarms are also provided in the control room. [However, none of these indications of loss of cooling water to the RCPs is safety grade as specified in the criteria of SRP Section 9.2.2. It is our position that this indication meet safety-related instrumentation guidelines.]

The containment supply and return headers are cross connected so that if one PCCW pump fails, all three reactor coolant pumps can be supplied with sufficient cooling water from the unaffected PCCW pump. The applicant has also demonstrated that the system can withstand a loss of offsite power without damage to RCP pump seals in accordance with Item II.K.3.25 of NUREG-0737 since the PCCW pumps are powered from onsite emergency sources.

During normal operation, all portions of the PCCW system are either in continuous or intermittent operation. Availability of the spare PCCW pump will be ensured by periodic tests and inspections per plant Technical Specifications. The system components are located in accessible areas to permit inservice inspection, as required. Thus, the requirements of General Design Criterion 45, "Inspection of Cooling Water System" and 46, "Testing of Cooling Water System" are satisfied.

Based on the above, we conclude that the PCCW system meets the requirements of General Design Criteria 2, 44, 45 and 46 with respect to protection against natural phenomena, decay heat removal capability, inservice inspection, and functional testing, and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2 with respect to the system's seismic classification, and is, therefore, acceptable except as noted above. The PCCW system meets the acceptance of SRP Section 9.2.2 except as noted. We will report resolution of our concern in a supplement to this SER.

9.2.2.2 Chilled Water System

The chilled water system is a closed-loop nonsafety-related system with the exception of the containment isolation valves and the piping between them which are seismic Category I, quality group B. The system provides cooling water during normal operation for the refueling water cooler, reactor containment air recirculation unit, gaseous water system coolers, waste gas system air ejection unit cooler, sweep gas chiller, post-accident sampling system, turbine plant sampling system, and air conditioning units in Auxiliary building, pipe tunnel, fuel building, control building, cable vault and rod control areas, condensate polishing building, waste handling building, and charcoal delay bed cubicles.

The chilled water system consists of three half-capacity self-contained chillers, three circulating pumps, two expansion tanks and associated piping and valves. Makeup water to the common pump suction header is provided from the demineralized water system. Cooling water for the chiller condenser is provided by the service water system (SWS) described in SER Section 9.2.1.1. A failure in the chilled water system will not affect safe shutdown of the plant. Emergency (backup) cooling requirements for the cable vault and rod control area ventilation system, and the reactor containment air recirculation unit are provided by the SWS in the event the chilled water system is unavailable. The cable vault and the rod control area ventilation system consists of redundant cooling coils, a normal chilled water cooling coil and a separate service water cooling coil, for use upon loss of the chilled water system. Cooling for the reactor containment air recirculation unit is manually transferred from the chilled water system to the SWS upon loss of the chilled water system. Adequate isolation between the chilled water system and SWS supply to the reactor containment air recirculation unit is provided by a seismic Category I check valve and motor operated valve in series. In addition, upon loss of the chilled water system, the control building ventilation system thermostatically activated pneumatic controlled air intake, exhaust and return air dampers will be modulated as necessary to vary the ratio of outdoor air being taken into the systems in order to maintain an acceptable space air temperature. Thus the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.2 are met.

Because the system serves no safety function, the requirements of GDC 44, 45, and 46 are not applicable.

Based on the above, we conclude that the chilled water system meets the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29 Position C.2, and is therefore acceptable. The system meets the applicable acceptance criteria of SRP 9.2.2.

9.2.2.3 Neutron Shield Tank Cooling Water System

The neutron shield tank cooling system is a safety-related, seisimc Category I, closed cooling water system. It provides cooling water to the neutron shield tank which is heated by neutron, gamma and thermal radiation from the reactor. It is a passive natural circulation system and consists of a neutron shield tank cooler, a surge tank, a corrosion control tank and associated piping and valves. Makeup to the system is provided by the reactor plant component cooling water system. Heat from the system is also rejected to the reactor plant component cooling water system. Thus the requirements of General Design Criteria 2 and 44 and the guidelines of Regulatory Guide 1.29 Position C.1 are met.

Based on the above, we conclude that the design of the neutron shield tank cooling system meets the requirements of General Design Criteria 2 and 44 and the guidelines of Regulatory Guide 1.29, Position C.1, and is therefore, acceptable. The system meets the applicable acceptance criteria of SRP 9.2.2.

9.2.3 Demineralized Water Makeup System

The demineralized water makeup system was reviewed in accordance with Section 9.2.3 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the demineralized water makeup system with respect to the applicable regulations of 10 CFR 50.

The nonsafety-related (nonseismic Category I) makeup demineralized water system supplies demineralized water to the reactor plant and turbine plant systems. The Beaver Valley Unit 2 demineralized water storage tank and distribution pumps are crosstied with the Beaver Valley Unit 1 storage tank so that water can be transferred between units. The demineralized water storage tanks for Units 1 and 2 each have a storage capacity of 600,000 gallons or a shared capacity of 1.2 million gallons. This volume is sufficient to provide makeup to both units when the water treatment system is inoperable.

The system has no safety-related functions. The system is not located near safety related systems. Protection of safety related equipment from flooding resulting from failure of the demineralized water makeup system is discussed in Section 9.3.3 of this SER. Failure of the system will not affect the capability to safely shut down the plant, thus, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.2 are met. Since the system serves no safety function, the requirements of General Design Criterion 5 do not apply.

Based on our review, we conclude that the makeup demineralized water system meets the requirements of General Design Criterion 2 with respect to the need for protection against natural phenomena because its failure does not affect safety system functions, and meets the guidance of Regulatory Guide 1.29, Position C.2 concerning its seismic classification, and is therefore, acceptable. The demineralized water makeup system meets the acceptance criteria of SRP 9.2.3.

9.2.4 Domestic Water and Sanitary Sewerage Systems

The domestic water and sanitary sewerage systems were reviewed in accordance with Section 9.2.4 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the domestic and sanitary sewerage systems with respect to the applicable regulations of 10 CFR 50.

The nonsafety-related (nonseismic Category I) domestic water system provides clean water for the drinking coolers, safety showers, eye wash units, and plumbing fixtures throughout the station. In accordance with the requirements of General Design Criterion 60, the domestic water system is not connected to any systems which have the potential for containing radioactive material. The domestic water is obtained from wells located southeast of the emergency response facility and treated by equipment located in an adjacent building. The treated water is stored in a 40,000 gallon capacity elevated storage tank. The domestic water system is protected by an air gap at interfaces with the sanitary sewerage system and other process systems.

The nonsafety-related (nonseismic Category I) sanitary sewerage system collects sanitary waster from plumbing fixtures throughout the station. The waste moves by gravity flow to a manhole and then flows to the Beaver Valley Unit 1 sewerage treatment facility which is designed to handle the requirements of both Units 1 and Unit 2.

Protection for safety-related equipment from floods resulting from failure of the domestic water and sanitary sewerage systems is discussed in Section 9.3.3 of this SER. The failure of the domestic or sanitary water systems will not affect plant safety.

Based on our review, we conclude that the domestic water and sanitary sewerage systems meet the requirements of General Design Criterion 60 with respect to prevention of contamination by radioactive water, and are therefore, acceptable. The domestic water and sanitary sewerage systems meet the acceptance criteria of SRP Section 9.2.4.

9.2.5 Ultimate Heat Sink

The ultimate heat sink was reviewed in accordance with Section 9.2.5 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the ultimate heat sink with respect to the applicable regulations of 10 CFR 50.

The ultimate heat sink (UHS) for Beaver Valley Unit 2 is the Ohio River. Sensible heat removed from both safety and nonsafety-related cooling systems during normal operation, shutdown, and accident conditions is discharged via the service water and standby service water systems.

The primary intake structure housing the service water pumps is designed to meet seismic Category I requirements and to withstand the effects of natural phenomena and missiles. The service water pump compartments and the pumps are designed to the high and low water conditions described in SER Sections 2.4.11 and 3.4.1. Thus, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29 Position C.1 are met.

In addition to the primary intake structure, an alternate intake structure and standby service water system has been provided for decay heat removal should the primary intake structure be disabled by a gasoline barge impact/explosion. As a minimum, the standby service water system can provide its design function during site-related historic events concurrent with a single active failure. Refer to Section 9.2.1 of this SER for further discussion.

The seismic Category I emergency outfall structure is located sufficiently downstream of both intake structures so as to ensure that recirculation of warm discharge water will not occur. Therefore, the inlet water temperature is unaffected by the service water system heat loads. The service water system is designed to handle the heat loads at the maximum river water temperature of 86°F at the low river water level. The method used for calculating the ultimate heat sink load due to fission product and heavy element decay is in accordance with Branch Technical Position ASB 9-2.

The UHS meets reactor cooling requirements including core decay heat and sensible heat and plant auxiliaries cooling requirements for an indefinite period and thus meets the requirements of General Design Criterion 44 and the guidelines of Regulatory Guide 1.27. Since spray ponds are not utilized, the guidelines of Regulatory Guide 1.72 "Spray Pond Plastic Piping" do not apply to BVPS-2. Further, since the UHS is a passive feature, the requirements of General Design Criterion 45 and 46 do not apply.

Based on the above, we conclude that the UHS meets the requirements of General Design Criteria 2 and 44 with respect to protection against natural phenomena and decay heat removal capacity and the guidelines of Regulatory Guides 1.27 for the design and functional requirements of the UHS, and 1.29 for seismic classification , and is, therefore, acceptable. The UHS meets the applicable acceptance criteria of SRP Section 9.2.5.

9.2.6 Condensate Storage Facilities

The condensate storage facilities were reviewed in accordance with Section 9.2.6 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the condensate storage facilities with respect to the applicable regulations of 10 CFR Part 50.

The condensate storage facilities are comprised of the demineralized water storage tank, the primary plant demineralized water storage tank and the secondary plant demineralized water storage tank. The storage capacity of the three tanks are 600,000 gallons, 140,000 gallons, and 200,000 gallons, respectively. The demineralized water storage tank is discussed in Section 9.2.3 and the primary plant demineralized water storage tank is discussed in Section 10.4.9.

The secondary plant demineralized water storage tank (SPDWST) is nonsafety related (non-seismic Category I) and provides condensate quality makeup water to the turbine plant condensate system. It is not required for safe shutdown and its failure will not affect the function of safety-related equipment. Depending on the water level in the condenser hot well, the SPDWST is capable of providing makeup water or accepting drawoff water from the condenser hot well. Freeze production for the SPDWST consists of a storage tank heater, a storage tank heater pump and heat-traced lines. The heat traced system is automatically activated when the temperature of the water in the line goes below 35°F. Thus, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.2 have been met with regard to protection of safety-related systems from failure in nonsafety-related systems.

The secondary plant demineralized water storage tank (SPDWST) is not shared with Beaver Valley Unit 1. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable.

The system was evaluated and found to have no function necessary for achieving safe reactor shutdown conditions or for accident prevention or mitigation.

The safety-related systems which receive water from the condensate storage facilities have either a safety class primary water supply or have sufficient storage capacity to perform their safety functions without additional makeup. Thus, the requirements of General Design Criteria 44, "Cooling Water," 45, "Inspection of Cooling Water System" and 46, "Testing of Cooling Water System," are not applicable.

Based on the above, we conclude that the condensate storage facilities meet the requirements of General Design Criterion 2 with respect to the need for protection against natural phenomena and the guidelines of Regulatory Guide 1.29, Position C.2 concerning seismic classification, and are, therefore, acceptable. The condensate storage facilities meet the applicable acceptance criteria of SRP Section 9.2.6.

9.2.7 Turbine Plant Component Cooling Water System

The turbine plant component cooling water system was reviewed in accordance with Section 9.2.3 of the Standard Review Plan (SRP), NUREG-0800. An audit review of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria of Section 9.2.3 formed the basis for our evaluation of the turbine plant component cooling water system with respect to the applicable regulations of 10 CFR 50.

The nonsafety-related (non-seismic Category I) turbine plant (secondary) component cooling water system removes heat from various nonsafety-related turbine plant components such as turbine oil coolers, electro hydraulic control fluid coolers, air comperssors, generator hydrogen coolers, air and hydrogen seal oil coolers, blowdown tank drain cooler, feedwater and condensate pump coolers, isolated phase bus duct air coolers, and auxiliary boiler blowndown vent condenser.

The turbine plant component cooling water system is designed as a closed cooling system and consists of a surge tank, a chemical addition tank, two 100 percent capacity circulating pumps, two 100 percent capacity heat exchangers, and associated piping and valves. The service water system provides the heat sink for this system. Makeup water is provided by the demineralized water system. System water chemistry and corrosion inhibition is maintained by chemical addition. The components of this system are located in the turbine building, waste handling building, auxiliary boiler enclosure, and condensate polishing building. Protection from flooding for safety-related systems as a result of failure in this system is discussed in Section 9.3.3 of this SER.

The system was evaluated and found to have no function necessary for achieving safe reactor shutdown conditions or for accident prevention or mitigation. The system is not directly connected to any safety-related system and is separated from safety-related equipment. Thus, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.2 are met.

Based on the above, we conclude that the turbine plant component cooling water system meets the requirements of General Design Criterion 2 and Regulatory Guide 1.29, Position C.2 with respect to the need for protection from natural phenomena, and is, therefore, acceptable. The system meets the acceptance criteria of SRP Section 9.2.3.

9.2.8 Primary Grade Water System

The nonsafety-related primary grade water system was reviewed in accordance with Section 9.2.6 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the primary grade water system with respect to the applicable regulations of 10 CFR 50.

The primary grade water system is a nonsafety-related system with the exception of the containment isolation valves and the piping between them which are seismic Category I, quality group B. It is a shared system in that the two Beaver Valley Unit 1 storage tanks and primary water pumps supply water to both Units 1 and 2.

This system is used exclusively in conjunction with the reactor plant systems. It provides reactor coolant makeup via the chemical and volume control system. It also supplies water for other miscellaneous services such as mixing water for the boric acid batching tank and for flushing resin from the ion exchangers. It consists of two 75,000 gallon primary grade water storage tanks and two supply pumps. The primary grade water storage tanks are supplied with water from the boron recovery system test tanks. Makeup water is obtained from the demineralized water system after having been routed through the primary water makeup deaerator.

The primary grade water system lines penetrating the containment are isolated on a containment isolation Phase A (CIA) signal. These lines and associated valves are designed to seismic Category I, quality group B requirements, and are inside tornado, missile, and flood protected buildings. Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification" Position C.1 are satisfied.

Since the primary grade water system is nonsafety related, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable. Protection from flooding for safety-related systems as a result of failure in this system is discussed in Section 9.3.3 of this SER.

The system was evaluated and found to provide no functions necessary for achieving safe reator shutdown conditions or for accident prevention or mitigation. Failure of the system will not affect safety-related system functions. Thus, the requirements of GDC 2 and the guidelines of Regulatory Guide 1.29 Position C.2 are satisfied. The safety-related systems which receive water from the primary grade water storage tank have either a safety class primary water supply or have sufficient storage capacity to perform their safety functions without additional makeup. Thus, the requirements of General Design Criteria 44, "Cooling Water," 45, "Inspection of Cooling Water System," and 46, "Testing of Cooling Water System," are not applicable.

Based on the above, we conclude that the primary grade water system meets the requirements of General Design Criterion 2 and the guidelines of Regulatory

Guide 1.29, Positions C.1 and C.2 and is, therefore, acceptable. The system meets the applicable acceptance criteria of SRP Section 9.2.6.

9.3.1 Compressed Air Systems

The compressed air system was reviewed in accordance with Section 9.3.1 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the compressed air system with respect to the applicable regulations of 10 CFR 50.

The station has three compressed air systems; the station air system, the condensate polishing air system and the containment instrument air system. The compressed air systems are not safety related except for the portion of the compressed air system that penetrates the containment between the containment isolation valves. The containment instrument air system, however, supplies compressed air to safety-related valves that are designed to fail in a safe position upon loss of compressed air. Those portions of the compressed air piping systems located inside seismic Category I buildings are seismically supported. The station air system is comprised of the station service air system and the station instrument air system. Both of these air systems are designed to provide compressed air of suitable quality and pressure to instrumentation and controls and to pneumatically operated tools. The station air system consists of two 100 percent capacity dry-screw oil free compressors that discharge into a common station air supply header located in the turbine building. Cooling water for the inter and after coolers is provided by the turbine plant component cooling water system.

The station instrument air requirements, external to the containment building, are supplied through a branch line from the station service air system common header. The main components of the station instrument air system are two desiccant-filled regenerative dehydrating towers, prefilters and afterfilters. In the event the station instrument air system pressure should drop to a predetermined value, an air-operated valve will automatically close and divert all station air to the station instrument air header.

The condensate polishing air system provides all compressed air requirements within the condensate polishing building. This air supply is used in the powered resin dewatering system, the chemistry lab and at various service hose connections. The compressed air is supplied by one 100 percent capacity dry-screw compressor. A backup source of compressed air is available by means of crossover line from the station service air system. The condensate polishing air system also acts as a backup air supply for the station air system via the same crossover line.

The containment instrument air system, a separate independent, compressed air system, consists of two 100 percent capacity oil free compressors, one 100 percent capacity refrigerant type air dryer, and compressor inlet and outlet filters. The compressors and dryer components are located in the main steam valve house. The system provides compressed air to safety-related valves, however the system is non safety-related because the valves are designed to fail in a safe position upon loss of compressed air. Two backup sources of compressed air for the containment instrument air system are available from the station service air system via a cross-connect within containment and the station instrument air system via a cross-connect within the main steam valve house.

The station air system, the station instrument air system, the condensate polishing air system and the containment instrument air system are nonsafety related except for the containment isolation valves and the piping in between which are designed to seismic Category I, Quality Group B requirements. The valves are located in a tornado-, missile- and flood-protected building. Therefore, these valves and associated piping meet the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Classification," Position C.1.

Unit 2 compressed air systems are not shared with Unit 1. Thus, the requirements of General Design Criterion 2, "Sharing of Structures, Systems and Components," are not applicable.

The applicant has proposed a preoperational test program for the instrument air system which includes effects of sudden and gradual loss of air pressure. In addition to the system operability verifications, preoperational tests and the initial startup tests described by the applicant, periodic tests will be performed on the standby compressor of the station air system to ensure its proper starting when required. Testing of the other air systems is not required, as they are normally in operation. On this basis, we conclude that the guidelines of Regulatory Guide 1.68.3 regarding properational tests of the instrument air system have been satsified.

The containment instrument air system and the station instrument air system condition the air so that dewpoints of the two systems are +35°F and -30°F, respectively. Further, filters are provided in the two systems to remove particles larger than 5 microns. This particle size is slightly larger than the 3 micron limit of ANSI MC 11.1-1976, "Quality Standard for Instrument Air." Considering the small difference in size and the minimal significance this size difference would make to the equipment utilizing this air, we consider that the applicant has met the intent of ANSI MC 11.1-1976. Oil free compressors minimize the oil content in the air. Inline moisture and pressure differential indicators and annunciators are provided to allow operator action to correct any air quality deviation. All safety-related air controlled components can be periodically tested to verify that upon loss of air they will respond by assuming their designated fail safe position. In addition, in order to ensure adequate operating performance, instrument air quality of the filter discharge will be tested annually for dewpoint and particular contamination. Thus, the air systems meets the requirements of General Design Criterion 1 with respect to the air quality standards by meeting the intent of ANSI MC 11.1-1976 as related to minimum instrument air quality standards.

Based on the above, we conclude that the compressed air systems meet the requirements of General Design Criterion 1, regarding instrument air quality, General Design Criterion 2, regarding protection from natural phenomena and the guidelines of Regulatory Guides 1.20, Position C.2, and 1.68.3 concerning seismic classification and preoperational testing of instrument air systems, and are, therefore, acceptable. The compressed air systems meet the acceptance criteria of SRP Section 9.3.1.

9.3.3 Equipment and Floor Drainage System

The reactor plant equipment and floor drainage systems were reviewed in accordance with Section 9.3.3 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" position of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the reactor plant equipment and floor drainage systems with respect to the applicable regulations of 10 CFR 50.

All drains are separated into those which contain air (aerated drains) and those which contain hydrogenated reactor cooling fluid. Aerated drains are piped to the liquid waste disposal (LWD) system (see Section 11.2 of the SER). Hydrogenated drains are piped to the boron recovery system for processing and recovery (i.e., returned to the reactor coolant system or processed for disposal). Drainage from non-radioactive sources such as the roof drain is discharged to the yard storm sewer system.

Except for containment penetration piping and valves, all components in the equipment and drainage systems are nonsafety related (nonseismic Category I). These systems collect and transfer potentially radioactive and non-potentially radioactive effluent in separate subsystems in each building and discharge to the gaseous or liquid waste system for treatment and disposal.

Aside from those sumps where small drainage is anticipated, such as the in-core instrument tunnel sump, the gaseous waste storage vault and the fuel pool telltale drain catch tank, all sumps will be provided with two full-sized and independently controlled sump pumps. Drainage from the turbine building is monitored for radioactivity and is pumped either to the yard drainage system or to the liquid waste system depending on its radioactivity level. Drainage from nonpotentially radioactive sources such as the roof drains are discharged to the yard storm sewer system. Therefore, the requirements of General Design Criterion 60, "Control of Releases of Radioactive Material to the Environment," with regard to collection of potentially radioactive waste are satisfied.

For those areas where safety-related equipment are located, check valves have been incorporated in the individual floor drain lines to provide assurance that compartment flooding will not occur due to back flow from other areas through the drain lines. Containment penetrations for the equipment and floor drainage system are designed to seismic Category I, quality Group B requirements and are located in seismic Category I, flood- and tornado-protected structures. Therefore, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Positions C.2 and C.2, are satisfied.

Safety-related equipment is protected from flooding damage by physical location within the buildings, or by Class IE water level instruments which provide indication of potential flooding. The areas of the plant where nonseismically designed piping and safety-related equipment are located together, are in the auxiliary building, safeguard building, control building, fuel and decontamination building, emergency diesel generator building, intake structure, and piping and electrical cable tunnels.

Below grade level (elevation 735'), the auxiliary building is separated by a wall into two areas, the north cubicle and the south cubicle. The north cubicle does not contain safety-related components that could be degraded by flooding. The maximum flood level in the south cubicle has been determined by the applicant to be 7 inches, which is below safety-related components. Significant accumulation of water would not occur on floors above the lowest elevation due to the stairwells, gratings, pipe sleeves, and duct penetrations. The auxiliary building south cubicle sump, located in the basement of the building, is provided with safety-related level instrumentation to alert the control room operator of a flooding condition within the area.

In the safeguards building, safety-related equipment is located in separate cubicled areas. Each of the areas in the lower elevations of the building are provided with sumps. The sumps contain safety-related level instrumentation which provide the control room operator with indication of flooding in the area. No significant accumulation of water would occur at elevations above the sump as a result of a rupture because of ladders, grating, and pipe sleeves, which allow the water to flow to lower levels.

In the emergency diesel generator building, safety-related equipment is separated into two cubicles, each housing one emergency diesel generator and its associated auxiliary systems. Flooding of the cubicles can not occur due to the activation of the fire protection system since it is a CO_2 type system. Assuming a failure of the engine cooling water system, there would be no significant accumulation of water within the building to affect safety-related equipment since the building is located on grade elevation and water could drain to the outside through doors and floor drains.

The fuel and decontamination building does not contain any high energy lines that could rupture and cause flooding. Further, should a pipe failure occur, there is a sump and two full-sized pumps located in the lowest elevation of the building. The sump also contains high-level detectors which will activate an annunciator in the control room.

The largest pipe in the control building areas containing safety-related equipment is a 6-inch service water line. Assuming a moderate energy crack in this line, a flood level of 5 inches would result. All safety-related equipment is located above this level.

The service building contains safety-related electrical/control equipment. Aside from a vertical pipe chase, the building does not contain any piping. Should a pipe failure occur in the pipe chase, water would flow down the vertical chase and flood a horizontal pipe tunnel below the service building. A sump is located in the horizontal pipe tunnel. There are no safety-related components in the flooded areas and the areas with electrical equipment remain dry.

The intake structure, shared by Beaver Valley Unit 1 and Unit 2 houses the three service water pumps. Each pump is separately housed in an individual watertight cubicle. The maximum internal flood of a cubicle would follow a moderate energy crack in the 30-inch service water line which would flood it to a depth of 10 feet and cause the pump to be inoperable. Only one of the three pumps is required for emergency shutdown. Water level instrumentation and control room alarms are provided to alert the operator of flooding conditions. Therefore, we conclude that the loss of one service water pump has no adverse safety considerations.

The remainder of the plant, the turbine building, waste disposal area, and condensate polishing area do not contain any safety-related equipment in areas of potential flooding. Also, a pipe rupture and flooding of any of these buildings will not affect any safety-related equipment in other plant areas.

Flood levels throughout the plant have been calculated assuming the failure of the drainage system due to events such as an earthquake. In those plant areas where safety-related equipment may be effected, safety-grade water level alarms will be installed. The calculated flood levels have been established assuming a leakage period of 30 minutes following the limiting pipe break. This interval will allow enough time for the operator to isolate the problem area. The safety-related equipment will be located above this calculated flood level or will be qualified for submergence. We conclude that the above described design satisfies the requirements of General Design Criterion 4, "Environmental and Missile Design Bases" with regard to internal flood protection.

Based on our review, we conclude that the equipment and floor drainage system meets the requirements of General Design Criteria 2, 4, and 60 as they relate to the protection against natural phenomena, provisions for internal flood protection and the prevention of radiological release to the environment and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2 concerning seismic classification, and is, therefore, acceptable. The equipment and floor drainage system meets the acceptance criteria of SRP Section 9.3.3.

9.4 Heating, Ventilation, and Air Conditioning (HVAC) Systems

9.4.1 Control Building Ventilation Sytem

The control building ventilation system was reviewed in accordance with Section 9.4.1 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the control building ventilation system with respect to the applicable regulations of 10 CFR 50.

The Beaver Valley Unit 2 control building ventilation system consists of two subsystems; the control room air-conditioning system and the control building air-conditioning system. The control rooms for Unit 2 and Unit 1 are located within the same pressure envelope. However, the control room area ventilation system for Units 1 and 2 are independent and physically separate systems. Further, the control and operation of the two air conditioning systems are not interconnected. Therefore, the requirements of General Design Criterion 5, "Sharing of Sturctures, Systems and Components," are not applicable to the control room air conditioning system. A seismic Category I backup bottled compressed air system, common to both Units 1 and 2, is provided and has been sized to accommodate both control rooms.

The Unit 2 control room ventilation system is designed to maintain a suitable environment for equipment operation and safety occupancy of the control room under all plant operating conditions. It serves the control room, the computer room, and the HVAC equipment room.

The Unit 2 control room air conditioning system is designed to seismic Category I, Quality Group C requirements and consists of two 100 percent capacity air conditioning units, each comprised of one fan, one service water cooling coil, a direct expansion cooling coil, a bag-type filter and a roll-type filter. During normal opreation, one of the two air conditioning units supplies a mixture of outside and return air to the control room. Redundant trains of the safety-related service water system provide cooling to the control room air conditioning units. The outside intake and exhaust air passes through reinforced concerete labyrinths designed to withstand tornado missiles. The control room ventilation system is located in two seismic Category I, missile, flood- and tornado-protected structures (i.e., the control building and auxiliary building). Redundant components are powered from separate Class IE emergency power supplies. Thus, the requirements of General Design Criteria 2, "Design Basis for Protectin Against Natural Phenomena" and 4, "Environmental and Missile Design Bases" and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1 regarding protection of the system from natural phenomena and the systems ability to maintain a suitable environment for equipment operation are met.

The compressed bottled air system installed in Beaver Valley Unit 1 will provide breathing quality air at positive pressure to the control room in the event of a containment isolation Phase B signal in either Unit 1 or Unit 2 or the detection of chlorine in the outside air intake ducts of either unit. Redundant, automatic, seismic Category I, detection and isolation equipment will isolate the system following the detection of radiation or chlorine and will annunciate an alarm in the control room. The air conditioning system will run in the recirculation mode for about sixty minutes. Once the compressed air supply is exhausted, one of two emergency control room supply air fans will automatically be activated. Outside air will pass through one of two redundant emergency filtration units (charcoal/adsorber and HEPA filters) and maintain a positive air pressure in the control room area. The positive pressure differential is maintianed by redundant isolation valves or dampers on inlet and exhaust openings. Thus, the above design satisfies the requirements of General Design Criterion 19, "Control Room," and the guidelines of Regulatory Guides 1.52, "Design, Testing, and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units for Light-Water-Cooled Nuclear Power Plants," Position C.2, 1.78, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," Positions C.3, C.7, and C.14, and 1.95, "Protection of Nuclear Power Plant Control Room Operators Against an Accidental Chlorine Release," Positions C.4.a and C.4.d. Refer to Sections 6.4 and 6.5.1 of this SER for further discussion of control room habitability and emergency filter design.

Smoke detectors are located at the air intake and in the control room area. The detectors at the air intake will isolate the air conditioning system from the outside air intakes and cause it to run in the 100 percent recirculation mode of operation. Should the control room area smoke detectors be activated, the system will run in the 100 percent purge mode of operation in order to exhaust the control room area of smoke.

The safety-related (seismic Category I, quality Group C) control building air conditioning system consists of two 100-percent capacity supply fans and two 100-percent capacity return/exhaust fans to provide heat removal and ventilation in the cable tunnels, instrument and relay room, cable spreading room, MCC room, and communications room (emergency shutdown panel). Heat is normally removed from the system cooling coils by the closed loop nonsafety-related chilled water system. Under emergency conditions where the chilled water is not available, the outside air intake, exhaust, and return air dampers will be modulated to maintain a constant temperature in the air leaving the space. The intake and exhaust air will pass through reinforced concrete labyrinths designed to withstand tornado missiles. System equipment is located within the seismic Category I, flood- and tornado-protected control and auxiliary buildings.

Since the control room is not a source of radioactivity and the emergency filtration system functions only following an accident, the requirements of General Design Criterion 60 and the guidelines of Regulatory Guide 1.140 are not applicable.

Based on the above, we conclude that the control building ventilation system meets the requirements of General Design Criteria 2, 4, and 19 and the guidelines of Regulatory Guides 1.29, Position C.1, 1.52, Position C.2, 1.78, Positions C.3, C.7, and C.14, and 1.95, Positions 4.a and 4.d, with respect to seismic classification, assuring a proper environment for equipment operation, uninterrupted safe occupancy of the control room and associated required manned areas under all normal and accident conditions including LOCA conditions in the event of a single active failure, and is, therefore, acceptable. The control building ventilation system meets the acceptance criteria of SRP Section 9.4.1.

9.4.2 Fuel and Decontamination Building Ventilation System (Spent Fuel Pool Area Ventilation System)

The fuel and decontamination building ventilation system was reviewed in accordance with Section 9.4.2 of the Standard Review Plan (SRP) NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the fuel and decontamination building ventilation system with respect to the applicable regulation of 10 CFR 50.

Except for the exhaust portions of the system, the fuel and decontamination building ventilation system, is a nonsafety-related (nonseismic Category I) system which serves the entire fuel and decontamination building. It is designed to maintain a suitable environment for equipment operation and personnel during normal plant operating conditions and to limit potential radioactive release to the atmosphere during normal operation and postulated fuel handling accident conditions. The system is not required to support operation of equipment required for safe shutdown.

The nonsafety-related recirculation portion of the fuel and decontamination building ventilation system operates under normal conditions and consists of a recirculation and supply air-handling unit with a roll filter, two chilled water cooling coils, two hot water reheat coils, a fan, controls, and a distribution ductwork. The ductwork is arranged so the air flow is from non-contaminated to potentially contaminated areas. The ductwork distribution system will withstand seismic forces (will not fall) so that safety-related equipment within the fuel building will not be damaged during postulated seismic events. Since the recirculation portion of the fuel and decontamination building ventilation system is nonsafety-related, safety-related equipment in the building has been qualified for the environment resulting from accident conditions and thus their function is not affected by the loss of the recirculation portion of the fuel and decontamination building ventilation system. Further, this safety-related equipment is capable of being monitored and operated from the control room, and thus access to the fuel and decontamination building is not required during accident conditions.

The safety-related (seismic Cateogry I, Quality Group C) exhaust portion of the fuel and decontamination building ventilation ductwork is a part of the supplementary leak collection and release system (SLCRS) (refer to Section 9.4.6 of this SER). The exhaust portion maintains a negative pressure in the fuel building by exhausting air from the building under normal plant conditions and on those occassions when the SLCRS radiation monitors in the ventilation exhaust are activated due to a radiological release accident. The radiation monitors are annunciatd in the control room. During both normal operation and emergency conditions when a radiological release has occurred, the exhaust air passes through one of the two moisture separators and either of the two redundant SLCRS filtration banks before being released to the atmosphere (see Section 9.4.6 of this SER for a discussion of the SLCRS). Each of the SLCRS filtration banks consists of a HEPA filter, a charcoal filter, and another HEPA filter. The two SLCRS banks receive their power from separate emergency buses.

All essential parts of the fuel and decontamination building ventilation system (i.e., the exhaust distribution system) are seismic Category I and are located in the seismic Category I, tornado missile, and external flood protected fuel and decontamination building. Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29 "Seismic Classification," Positions C.1 and C.2 are satisfied.

There are no high energy lines or systems located near the fuel and decontamination building ventilation exhaust system. Thus, adequate protection against internally generated missiles and the effects of pipe whip and fluid jets is provided by separated equipment locations (refer to 3.5.1.1 and 3.6.1 of this SER).

Beaver Valley Unit 2 has its own fuel and decontamination building and ventilation system. No portion of the ventilation system is shared with BVPS-1. Therefore, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components" are not applicable.

As described above, the fuel and decontamination building ventilation system in conjunction with the supplementary leak collection and release system as discussed in Section 9.4.6 of this SER meets the requirements of General Design Criteria 60, "Control of Release of Radioactive Materials to the Environment," and 61, "Fuel Storage and Handling and Radioactivity Control" and the guidelines of Regulatory Guide 1.13, Position C.4, "Spent Fuel Storage Facility Design Basis," Regulatory Guide 1.52, Position C.2, "Design, Testing and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," and Regulatory Guide 1.140, Position C.1 and C.2, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air-Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

Based on the above, we conclude that the fuel and decontamination building ventilation system is in conformance with the requirements of General Design Criteria 2, 60, and 61 as they relate to protection against natural phenomena and control of releases of radioactive materials, and the guidelines of Regulatory Guides 1.13, Position C.4, 1.29, Positions C.1 and C.2, 1.52, Position C.2, and 1.140, Positions C.1 and C.2 relating to the ventilation system capability to provide protection against radioactive releases, seismic classification, and ventilation system filtration design for emergency and normal operation, and is, therefore, acceptable. The fuel and decontamination building ventilation system meets the acceptance criteria of SRP Section 9.4.2.

9.4.3 Auxiliary Building and Radwaste Area Ventilation System

The auxiliary building and radwaste area ventilation system was reviewed in accordance with Section 9.4.3 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the auxiliary building and radwaste area ventilation system with respect to the applicable regulations of 10 CFR 50.

The auxiliary building and radwaste area ventilation system is designed to minimize the spread of airborne radioactive material and to maintain a suitable environment for personnel access by removing heat released from equipment, piping, and lighting during normal operation. With the exception of a portion of the auxiliary building exhaust system, the auxiliary building and radwaste area ventilation system is nonsafety related (nonseismic Category I). The auxiliary building exhaust system serves those portions of auxiliary building housing equipment required during accident conditions (i.e., the primary component cooling water pump general area and the charging pump cubicles) and is safety related, seismic Category I. This exhaust system is connected to the supplementary leak collection and release system (SLCRS) described in Section 9.4.6 of this SER. The SLCRS exhaust system consists of redundant fans powered from separate Class 1E sources and serves as the exhaust system for the auxiliary building and radwaste area (refer to Section 9.4.6 of this SER for further discussion).

The spread of contamination is minimized by directing the supply air to clean areas, maintaining the building areas under a slightly negative pressure by exhausting at a rate higher than the supply air rate, and by controlling the flow paths from areas of lesser potential for contamination to areas of greater potential for contamination.

The auxiliary building ventilation system consists of two air handling units each of 50 percent capacity. The air handling units include a preheat coil using hot water as the heating medium, a cooling coil using chilled water, a reheat coil, and a fan. The radwaste area ventilation system is an extension of the auxiliary building ventilation system. In addition, two redundant, safety-related recirculation type ventilation trains are located in the enclosure at el. 755'-6", and function to circulate air in the motor control center (MCC) areas in the auxiliary building for heat removal. The equipment within the enclosure is housed within seismic Category I, missile protected structures and is powered from redundant Class IE power sources. Each train consists of a full capacity enclosure fan and a cooling coil. The cooling coils transfer heat to the service water system.

All air exhausted from the auxiliary building and radwaste area passes through the safety-related (seismic Category I), redundant filters of the SLCRS. Airborne particulate and noble gases are continually sampled and analyzed by a radiation monitoring system. Thus, the requirements of General Design Criterion 60, "Control of Release of Radioactive Material to the Environment," and the guidelines of Regulatory Guide 1.140, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," Positions C.1 and C.2 are satisfied.

The auxiliary building ventilation system is located in the auxiliary building, which is a seismic Category I, flood and tornado protected structure (see Section 3.4.1 ad 3.5.2). The failure of any nonsafety-related equipment will not affect essential functions of safety-related equipment. Essential (safety-related) portions of the system itself are seismic Category I, quality Group C, and are physically separated from high-energy systems. Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Positions C.1 and C.2 are satisfied.

The auxiliary building and radwaste area ventilation system is not shared, and therefore the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," do not apply.

Based on the above, we conclude that the auxiliary building and radwaste area ventilation system is in conformance with the requirements of General Design Criteria 2 and 60 as they relate to protection against natural phenomena, and control of releases of radioactive materials to the environment and the guidelines of Regulatory Guides 1.29 (Positions C.1 and C.2), and 1.140 (Positions C.1 and C.2), relating to seismic classification and ventilation system design for normal operation, and is therefore acceptable. The auxiliary building and radwaste area ventilation system meets the acceptance criteria of SRP Section 9.4.3.

9.4.4 Turbine Building Ventilation System

The turbine building ventilation system was reviewed in accordance with Section 9.4.4 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the turbine building ventilation system with respect to the applicable regulations of 10 CFR 50.

The turbine building ventilation system removes the heat dissipated from equipment, piping, and lighting in the turbine building during normal operation. The supply portion of the system consists of two axial flow fans with associated ductwork, intake louvers, and dampers. Two circulating fans circulate air within the turbine building before it is exhausted by the exhaust system. The exhaust portion of the system consists of ten axial flow fans located on the turbine building roof, one machinery room elevator exhaust fan, one toilet room fan, and one nonessential battery room exhaust fan.

The turbine building ventilation system is classified as nonsafety related (nonseismic Category I). The system maintains an acceptable environment for personnel and the nonessential equipment served during normal plant operation. The system has no safety functions. The system is separated from safety-related plant systems and potentially radioactive areas. Therefore, failure of the system will not compromise the operation of any essential plant systems or result in an unacceptable release of radioactivity. Thus, it meets the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.2.

Based on the above, we conclude that the turbine building ventilation system meets the requirements of General Design Criterion 2 with respect to the need for protection against natural pheonmena as its failure does not affect safety system functions, or result in release of radioactive material, and the guidelines of Regulatory Guide 1.29, Position C.2, concerning its seismic classification, and is, therefore, acceptable. The turbine area ventilation system meets the acceptance criteria of SRP Section 9.4.4.

9.4.5 Engineered Safety Features Ventilation Systems

The engineered safety features (ESF) ventilation systems were reviewed in accordance with Section 9.4.5 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the engineered safety features ventilation systems with respect to the applicable regulations of 10 CFR 50.

The engineered safety feature ventilation system (ESFVS) is comprised of the following ventilation systems:

1. emergency diesel generator ventilation system (9.4.5.1)
2. intake structure ventilation system (9.4.5.2)
3. main steam and feedwater valve area ventilation system (9.4.5.3)
4. battery room ventilation system (9.4.5.4)
5. emergency switchgear ventilation system (9.4.5.5)
6. safeguards area ventilation system (9.4.5.6)
7. cable vault and rod control area ventilation system (9.4.5.7)
8. alternate shutdown panel room ventilation system (9.4.5.8)

The above systems serve various areas of BVPS-2 that house engineered safety features (ESF) equipment. These systems use outside air or service water, or a combination of these to provide a suitable and controlled environment for personnel and equipment. Control of radiological release and compliance with the requirements of General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," for the ESF areas is discussed in Section 9.4.6 of this SER.

Discussion of ventilation requirements for assuring a suitable environment for the safety-related residual heat removal pumps which are located inside containment is provided in Section 5.4.7 of this SER.

9.4.5.1 Emergency Diesel Generator Building Ventilation System

The emergency diesel generator building ventilation system is a safety-related system provided to remove the heat released within the building by the equipment and lighting in order to maintain conditions suitable for personnel and equipment during normal and post-accident conditions. This system is composed of three subsystems: the normal exhaust fan, the primary supply fan, and the secondary supply fan which are housed within the seismic Category I diesel generator buildings.

Each of the two diesel generator compartments is provided with its own ventilation system consisting of an individual normal exhaust fan subsystem and primary and secondary supply fan subsystem. The exhaust subsystem is designed to prevent the accumulation of gases of fuel-vapor mixtures by exhausting the air that enters by infiltration through back-draft dampers. The primary supply fan is started when its associated emergency diesel generator starts in order to remove the heat generated by the diesel engine, engine exhaust sytem, generator, and lighting sources. Each primary supply fan works in conjunction with seismically supported, motorized, outdoor air and return air dampers, ductwork, and control instrumentation. The air supplied to the secondary supply fan for each compartment is drawn from the mixing plenum of the primary supply fan. The secondary supply fan is automatically controlled and electrically interlocked with the primary supply fan and is energized to prevent the room ambient temperature from exceeding a preset value. It will operate provided no fire generated high temperature exists in the room. In the event that the CO_2 fire protection system is discharged into the compartment, the associated primary supply fan will not start and the normal exhaust fan will shut off. All air intake and exhausts are protected from missiles by reinforced concrete barriers. Unit heaters controlled by wall-mounted thermostats are also provided in each of the diesel generator compartments to maintain a predetermined temperature. Control room annunciation is provided for primary supply fan motor thermal overload and compartment high and low temperatures.

The above subsystems are independent of the diesel engine combustion air intake and exhaust openings. Upon loss of normal station power, power to the normal, primary, and secondary fans as well as the motorized dampers are automatically transferred to the emergency buses. The air intakes for both the compartment ventilation system and diesel engine consist of reinforced concrete hoods with intake screens located at elevation 759'-0". The engine exhaust exits from an opening protected by a reinforced concrete missile barrier at elevation 780'-0". Grade elevation is 732'-6". In this regard, the requirements of General Design Criterion 17, "Electric Power System," and the recommendations of NUREG/CR-0660 are satisfied in that engine combustion air intake and the compartment ventilation air intake is 26'-6" above grade which exceeds the recommended minimum of 20'-0". Thus, the likelihood of dust being the cause of electrical malfunction has been suitably reduced. Further, since the engine exhaust is released at elevation 780'-0" and the engine combustion air and compartment ventilation is taken at elevation 759'-0" from a point that is spatially removed from the engine exhaust, we conclude that the likelihood of engine exhaust mixing with ventilation intake air is sufficiently remote, and therefore, acceptable.

The ventilation systems are designed to seismic Category I, quality Group C criteria. They are housed within a building capable of withstanding natural phenomena. Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guideline of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1 are satisfied. The ventilation systems have been designed to withstand the effects of external missiles and to provide adequate air for assuring diesel engine function during all operating modes. Therefore, the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," have been satisfied. Since the BVPS-2 emergency diesel generator building ventilation system is not shared with BVPS-1, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable. The ventilation system fans, dampers, and associated controls are powered from the emergency bus associated with the diesel engine it serves in the event of loss of offsite power. A failure in the emergency generator ventilation system in one compartment will not affect the ventilation system for the redundant diesel generator, thus meeting the single failure criterion.

Based on the above, we conclude that the emergency diesel generator building ventilation system is in conformance with the requirements of General Design Criteria 2, 4, and 17 as they relate to protection against natural phenomena, thus assuring a suitable environment for operation of the emergency diesel generators, and meets the guidelines of Regulatory Guide 1.29, Position C.1 and NUREG/CR-0660 as relates to seismic design classification and protection against dust accumulation, and is therefore acceptable. Thus, the emergency diesel generator building ventilation system meets the acceptance criteria of SRP Section 9.4.5.

9.4.5.2 Intake Structure Ventilation System

The intake structure ventilation system consists of two subsystems; the primary intake structure ventilation system and the alternate structure ventilation system.

9.4.5.2.1 Primary Intake Structure Ventilation System

The Beaver Valley Unit 2 primary intake structure ventilation system serves the three safety-related independent and redundant pump cubicles which house the Unit 1 and Unit 2 safety-related service water pumps. These three cubicles also house the Unit 1 safety-related pumps. The active components of the Unit 2 ventilation system are independent of the Unit 1 ventilation system.

The primary intake structure ventilation system is a safety-related system which provides a suitable environment for personnel and equipment during both normal and accident conditions. The primary intake structure ventilation system consists of three full capacity, separate, independent fans, three outdoor air intake dampers, and three roof ventilators. The outdoor air intake and exhaust openings are missile protected. The ventilation system is powered by the respective emergency buses supplying power to the associated service water pumps (i.e., two fans are powered from separate emergency buses and the third fan has the capability of being powered by either emergency power source. Electric unit heaters are also connected to the emergency buses and provide the heating requirements for personnel access.

The ventilation system is quality Group C, and seismic Category I, except for the electric unit heaters. The heaters are seismically supported but not seismically designed. They are not required to operate following an SSE, as safety-related equipment is qualified for operation in the environment which results from their failure. The system is located in the seismic Category I, tornado and flood protection portions of the intake structure. Therefore, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.1 are satisfied. The active components are not shared with BVPS-1, and thus the requirements of General Design Criterion 5 are not applicable. Loss of a ventilation system active component will only affect the operation of one service water pump, thus assuring required safe shutdown capability in the event of a single failure. Therefore, the requirements of General Design Criterion 4 for assuring a suitable environment for essential equipment operation are satisfied.

Based on the above review, we conclude that the primary intake structure ventilation system is in conformance with the requirements of General Design Criteria 2 and 4, as they relate to protection against natural phenomena, and the capability to assure a suitable environment for equipment operation, and meets the guidelines of Regulatory Guide 1.29, Position C.1 as they relate to seismic classification and is, therefore, acceptable. The primary intake structure ventilation system meets the applicable acceptance criteria of SRP Section 9.4.5.

9.4.5.2.2 Alternate Intake Structure Ventilation System

The alternate intake structure ventilation system provides an environment suitable for personnel and equipment operation during normal plant operator and loss of the primary intake structure due to a postulated barge explosion. It is a nonsafety-related (nonseismic Category I) system in accordance with the design of the standby service water system and is located in the alternate intake structure which is separated from the primary intake structure. The system consists of two 100 percent capacity redundant exhaust fans each with its own intake and exhaust dampers and associated ductwork.

When the temperature within the structure rises, the intake and exhaust dampers automatically open. A further rise in temperature will cause the exhaust fan to automatically start. Should the temperature decrease below a preset value, electric heaters will be activated. A trouble alarm is provided in the main control room for indication of malfunction in the ventilation system. The power supplied to the damper actuators and fans is from redundant emergency buses. Power to the electric heaters is provided from a nonessential supply. The system does not serve safety-related equipment, therefore its failure will not affect safety-related equipment function. Therefore, the requirements of General Design Criteria 2 and 4 and the guidelines of Regulatory Guide 1.29, Position C.2 are met. The system is not shared, and therefore the requirements of General Design Criterion 5 are not applicable.

Based on the above, we conclude that the alternate intake structure ventilation system is in conformance with the requirements of General Design Criteria 2 and 4 as relates to the need for protection against natural phenomena, and the capability to provide a suitable environment for equipment operation, and meets the guidelines of Regulatory Guide 1.29, Position C.2 for seismic design classification, and is, therefore, acceptable. Thus, the system meets the applicable acceptance criteria of SRP Section 9.4.5.

9.4.5.3 Main Steam and Feedwater Valve Area Ventilation System

The main steam and feedwater valve area ventilation system is a safety-related system provided to maintain a suitable environment for personnel access and equipment operation during all modes of plant operation except a high energy line break in the main steam and feedwater valve area. Essential equipment in these areas will be qualified to function as required following a steam/feedwater line break (refer to SER Section 3.11 for further discussion). The system consists of two 100 percent capacity redundant ventilation trains each having a fan, a roll-type filter, dampers, cooling coils, temperature control valves, ductwork, and supply and exhaust grills. The main steam and feedwater valve area ventilation system is seismic Category I, quality Group C. It is a closed system in that the area air is recirculated and cooled by the cooling coils. There are no outside air intakes, and thus external missiles cannot affect the system. The cooling coils are served by redundant trains of the safety-related service water system. The main steam and feedwater valve area is maintained under a negative pressure by the supplementary leak collection and release system as described in Section 9.4.6 of this SER. The ventilation system is housed within a portion of the main steam and feedwater valve house which is a seismic Category I, tornado and flood protected structure. Therefore, the requirements of General Design Criteria 2 and 4 and the guidelines of Regulatory Guide 1.29 Position C.1 are met.

Normally one of the two trains is in operation while the other is on standby. Should a loss of air flow be detected, the standby train will automatically start. The ventilation trains are powered from redundant Class IE sources. The service water flow control valves to the cooling coils are air operated. Upon loss of air, the control valves will fail open to ensure service water flow to the cooling coils.

As the BVPS-2 ventilation system is not shared with BVPS-1, the requirements of General Design Criterion 5 are not applicable.

Based on the above, we conclude that the main steam and feedwater valve area ventilation system is in conformance with the requirements of General Design Criteria 2 and 4 as they relate to protection against natural phenomena, and the system being capable of providing a suitable environment for equipment operation, and the guidelines of Regulatory Guide 1.29, Position C.1 as related to the seismic design classification, and, is therefore acceptable. The main steam and feedwater valve area ventilation system meets the applicable acceptance criteria of SRP Section 9.4.5.

9.4.5.4 Battery Room Ventilation System

The battery room ventilation system is provided to preclude the buildup of hydrogen in excess of 2 percent by volume in the five battery rooms. Four of the battery rooms are located in the emergency switchgear area at elevation 730'-6" of the service building and one is located at the 760'-6" elevation of the service building. Ventilation of these rooms is accomplished by the safety-related portion of the service building ventilation system. Incoming air is drawn into the battery rooms from the adjacent emergency switchgear rooms. The system consists of two 100 percent capacity redundant exhaust fans, fire dampers, ductwork, and supply and return air grills and dampers. Each fan is powered from a separate emergency power source. The system is seismic Category I, quality group C, and is located in the seismic Category I tornado and flood protected portion of the service building. The exhaust opening is protected by a reinforced concrete missile barrier. Therefore, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.1 are met.

The control switches for the exhaust fans and associated indicating lights are located in the control room. A zero pressure differential across one exhaust fan will automatically start the redundant fan. Alarms are provided for indication of automatic start or stop of the exhaust fans. Therefore, we conclude that the requirements of General Design Criterion 4 are satisfied. The system is not shared and thus the requirements of General Design Criterion 5 are not applicable.

Based on the above, we conclude that the battery room ventilation system is in conformance with the requirements of General Design Criteria 2 and 4, as they relate to protection against natural phenomena and assuring the proper functioning of essential equipment, and meets the guidelines of Regulatory Guide 1.29, Position C.1 as related to seismic design classification and is therefore acceptable. The battery room ventilation system meets the applicable acceptance criteria of SRP 9.4.5.

9.4.5.5 Emergency Switchgear Room Ventilation System

The emergency switchgear room ventilation system is provided to maintain a suitable environment for personnel and equipment operation during all operating conditions including emergencies. The system is safety related, seismic Category I, quality Group C, and is located in the service building.

The system consists of two parallel, redundant trains each with a 100 percent capacity supply fan, cartridge-type throwaway filter and full capacity exhaust fan, and associated distribution ductwork and dampers. Both of the ventilation trains draw incoming air and exhaust air through missile protected openings.

The outdoor air, recirculated air, and exhaust air dampers are modulated by a temperature controller to maintain the area temperatures within acceptable limits. Electric heaters are provided for this purpose. The redundant fans and associated motor-operated dampers are powered by separate emergency buses. The system is located in a seismic Category I, flood and tornado missile protected structure. Thus, the system meets the requirements of General Design Criteria 2 and 4 and the guidelines of Regulatory Guide 1.29 Position C.1. The emergency switchgear room ventilation system is not shared with BVPS-1 and therefore the requirements of General Design Criterion 5 are not applicable.

Based on the above, we conclude that the emergency switchgear room ventilation system is in conformance with the requirements of General Design Criteria 2 and 4 as they relate to protection from the effects of natural phenomena and providing a suitable environment for equipment operation, and the guidelines of Regulatory Guide 1.29, Position C.1 as they relate to seismic design classification, and is therefore acceptable. The emergency switchgear room ventilation system meets the applicable acceptance criteria of SRP Section 9.4.5.

9.4.5.6 Safeguards Area Ventilation System

The safeguards area ventilation system provides a suitable environment for equipment operation including the quench spray pumps, high head safety injection pumps, low head safety injection pumps, and the auxiliary feedwater pumps during accident conditions and personnel access during normal plant operation. It is designed so that the safeguard area temperature will not exceed 120°F when the equipment in this area is in operation.

The safeguards area ventilation system is located in the safeguards area and consists of two identical redundant subsystems, the south safeguards area ventilation system, and the north safeguards area ventilation system. No portion of the system is shared with BVPS-1 and thus, the requirements of General Design Criterion 5 do not apply. The system is seismic Category I, quality Group C. The safeguards area is a seismic Category I reinforced concrete structure designed to provide tornado protection for the engineered safety features pumps, valves, and piping penetrations. Thus, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Position C.1 are met.

Each of the two ventilation subsystems consists of a full capacity air conditioning unit with a fan, service water cooling coils, volume control dampers, supply grills, distribution ductwork, and electric unit heaters. They are powered by redundant Class IE power sources to assure their operability during accident conditions. The failure of one of the subsystems will not impair the ventilation subsystem for the redundant safeguards area and, therefore, meets the single failure criterion. The safeguards areas are maintained under a negative pressure by the supplementary leak collection and release system which prevents the spread of airborne radioactive contamination (refer to SER Section 9.4.6). Thus, the requirements of General Design Criterion 4 are met.

Based on the above, we conclude that the safeguards area ventilation system is in conformance with the requirements of General Design Criteria 2 and 4 as they relate to protection against natural phenomena and maintaining a suitable environment for equipment operation, and the guidelines of Regulatory Guide 1.29, Position C.1 as related to seismic design classification, and is therefore acceptable. The safeguards area ventilation system meets the applicable acceptance criteria of SRP Section 9.4.5.

9.4.5.7 Cable Vault and Rod Control Area Ventilation System

The cable vault and rod control area ventilation system provides a suitable environment for equipment operation during normal and accident conditions and personnel access. It operates in a 100% recirculation mode and therefore has no outside air intake or exhaust. The system consists of two redundant, parallel, 100% capacity air conditioning units, volume control dampers, supply and return air grills, and the associated ductwork. Each air conditioning unit has a chilled water cooling coil, a service water cooling coil, a hot water heating coil, and a roll-type filter and centrifugal fan. Normally, one train is in operation and the other train is in standby. Should a unit fail to start, as the result of a high area temperature, the standby unit is automatically started, thus assuring system in function the event of a single failure.

During normal operation the chilled water cooling coil in the air conditioning unit is used to cool the recirculated air. When the chilled water system is unavailable such as during emergency conditions, the safety-related service water coil is used for cooling. The water flow in the hot water heating coil and chilled water cooling coil is modulated by the return air thermostat. The air conditioning units and associated controls are supplied with emergency power during emergency conditions to ensure this operation. Thus, the requirements of General Design Criterion 4 are satisfied.

The area is maintained under a negative pressure by the Supplementary Leak Collection and Release System as described in Section 9.4.6 of this SER.

No portion of this system is shared with BVPS-1, therefore General Design Criterion 5, "Sharing of Structures, Systems and Components," is satisfied.

The system is seismic Category I, quality Group C. The cable vault area which houses the ventilation system within the seismic Category I portion of reinforced concrete structure capable of withstanding tornadoes and floods. Therefore, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1 are satisfied.

Based on the above, we conclude that the cable vault and rod control area ventilation system is in conformance with the requirements of General Design Criteria 2 and 4 as they relate to protection against natural phenomena and maintaining a suitable environment for equipment operation and the guidelines of Regulatory Guide 1.29, Position C.1 as related to seismic classification, and is therefore acceptable. The cable vault and rod control area ventilation system meets the applicable acceptance criteria of SRP Section 9.4.5

9.4.5.8 Alternate Shutdown Panel Room Ventilation System

The alternate shutdown panel (ASP) is located in its own room at elevation 755'-6" in the auxiliary building/cable tunnel. The ASP room ventilation system is provided to maintain a suitable environment for personnel and safe shutdown equipment operation following a postulated exposure fire in the cable spreading room, instrumentation and relay room, west communication room (emergency shutdown panel), or cable tunnel. Refer to Section 9.5.1 of this SER for further discussion regarding the post-fire alternate shutdown capability.

The ASP ventilation system consists of one self-contained air conditioning unit, an electric duct heater, volume control dampers, fire dampers, supply air diffuser, return air grill, and related duct work. The air conditioning unit employs an expansion cooling coil, a water-cooled condenser, a cartridge-type air filter, and a centrifugal fan.

The ASP room is independent for each unit, thus the requirements of GDC 5 are not applicable.

The ASP room ventilation system is not operated during normal plant operation except during periodic testing. It is started manually and is controlled by room thermostats. The ventilation system operates in a recirculation mode with a small amount of outside air providing pressurization necessary to eliminate infiltration. Outside air is drawn from an area independent of the postulated fire areas for which the ASP must be available.

The air conditioning unit and associated controls are classified seismic Category I and are supplied with Class IE electric power. The system is not redundant because a fire and additional accidents or failures which might render other means of safe shutdown (either the control room or emergency shutdown panel) inoperable, are not postulated to occur simultaneously. The ASP ventilation system is housed in a seismic Category I, flood- and tornado-protected building. Thus, the system meets the requirements of GDC 2 and 4 with respect to protection against natural phenomena and assurance of proper operating environment for essential equipment and the guidelines of Positions C.1 and C.2 of Regulatory Guide 1.29 for seismic design.

Based on the above, we conclude that the alternate shutdown panel room ventilation system is in conformance with the requirements of General Design Criteria 2 and 4 as they relate to protection against natural phenomena and maintaining a suitable environment for equipment operation, and the guidelines of Regulatory Guides 1.29, Positions C.1 and C.2 as related to seismic classification, and is therefore acceptable. The alternate shutdown panel room ventilation system meets the applicable acceptance criteria of SRP Section 9.4.5.

9.4.6 Supplementary Leak Collection and Release System

The supplementary leak collection and release system was reviewed in accordance with Section 9.4.2 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed, according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the supplementary leak collection and release system with respect to the applicable regulations of 10 CFR 50.

The function of the supplementary leak collection and release system (SLCRS) is to collect and filter potential radioactive leakage from the cable vault and rod control area, charging pump cubicles, primary component cooling water pump area, safeguards area, solid waste handling building, auxiliary building, main steam and feedwater valve area, and the fuel and decontamination building prior to discharge to the atmosphere. It consists of two normal nonsafety-related exhaust fans, two redundant safety-related leak collection filter exhaust fans, four filter banks, and two redundant emergency charging pump cubicle exhaust fans. The capacity of the exhaust fans are in excess of the estimated air leakage and therefore ensures a negative pressure in the areas served. Measures have been taken to limit the in-leakage to the respective areas.

During normal plant operation, one of the two normal leak collection exhaust fans is in operation and the other fan is on standby. Except for air from the solid waste handling building, auxiliary building charging pump cubicles, primary component cooling water pump area, main steam and feedwater valve area and the fuel and decontamination building (SLCRS areas), the exhaust air is unfiltered. The exhaust air from the SLCRS areas above is normally demisted, filtered, and exhausted by the leak collection filter exhaust fans.

Upon receipt of a containment isolation Phase A signal, the normally unfiltered air is directed through one of the two demister and filter assemblies before being exhausted by the leak collection filter exhaust fans. The other SLCRS train is maintained on standby.

The SLCRS includes redundant, 100 percent capacity leak collection exhaust fans, demister assemblies, main filter banks, and dampers. The redundant fans, electric heating coils, and dampers are connected to separate emergency buses. Therefore, there is sufficient redundancy in the system to ensure system function in event of a single failure. Thus, the requirements of General Design Criterion 60, "Control of Release of Radioactive Materials to the Environment," and the guidelines of Regulatory Guides 1.52, "Design, Testing and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," Position C.2, and 1.140, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light Water Cooled Nuclear Power Plants," Positions C.1 and C.2 are met. Refer to Section 9.4.2 of this SER for discussion of ventilation system compliance with General Design Criterion 61 and Regulatory Guide 1.13.

The SLCRS is seismic Category I, quality Group C and is located in the upper portion of the seismic Category I auxiliary building. This portion of the building does not provide protection from tornadoes, hurricanes, or missiles. The design calculations of the cooling requirements for safety-related equipment does not take credit for the cooling effect provided by the operation of the SLCRS. Further, it is assumed that accidents requiring SLCRS function (such as a LOCA) will not occur concurrent with these natural phenomena. Therefore, protection of the SLCRS from tornadoes and tornado missiles is not required, as its function is not essential for assuring safe shutdown following a tornado. Thus, we conclude that the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29 "Seismic Design Classification" Position C.1 and C.2 are met. The supplementary leak collection and release system is not shared with BVPS-1, therefore, the requirements of General Design Criterion 5 "Sharing of Structures, Systems and Components" are not applicable.

Based on our review, we conclude that the SLCRS meets the requirements of General Design Criteria 2 and 60 with regard to protection against natural phenomena and providing protection against radioactive releases, and the guidelines of Regulatory Guides 1.29, Positions C.1 and C.2, 1.52, Position C.2, and 1.140, Positions C.2 and C.2 concerning seismic classification and emergency and normal ventilation system filtration design, and is, therefore, acceptable. The SLRCS meets the acceptance criteria of SRP Section 9.4.2.

10.3 Main Steam Supply System

The main steam supply system was reviewed in accordance with Section 10.3 of the Standrad Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria except as noted below formed the basis for our evaluation of the main steam supply system with respect to the applicable regulations of 10 CFR 50.

The acceptance criteria for the main steam supply system includes meeting Regulatory Guide 1.115, "Protection Against Low Trajectory Turbine Missiles." Compliance with the guidelines of Regulatory Guide 1.115 is evaluated separately in Section 3.5.1.3 of this SER.

The function of the main steam supply system is to convey steam from the steam generators to the high-pressure turbine and other auxiliary equipment for power generation. The steam produced in the three steam generators is conveyed in three separate main steam lines from the steam generators through the main steam isolation valves to a main steam header and then through four lines to the high-pressure turbine. Each of the three main steam lines contains one main steam isolation valve (MSIV). The portions of the main steam lines from the steam generators through the containment, including the main steam isolation valves, the main steam safety valves, the power-operated atmospheric dump valves, and a residual heat release control valve are located in the seismic Category I, flood- and tornado-protected main steam and feedwater valve building (refer to Sections 3.4.1 and 3.5.2 of this SER), thus complying with the guidelines of Position C.2 of Regulatory Guide 1.29, "Seismic Design Classification," relating to protection of the main steam line from damage caused by failure of other systems as a result of an SSE. The lines are designed to quality Group B and seismic Category I standards up to and including the main steam isolation valve. The lines from the main steam isolation valves to the turbine building wall are designed to quality Group C, seismic Category I standards, as is the line to the auxiliary feedwater pump steam turbine. All branch lines from the seismic Category I, quality Group B portions of the main steam line up to and including the first normally closed valve in the branch line are also designed to seismic Category I, quality Group B standards, thus complying with the guidelines of Positions C.1.f and C.3 of Regulatory Guide 1.29 relating to the design of portions of main and branch steam lines and the extension of seismic Category I requirements. Thus, this portion of the main steam line satisfies the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

Main steam isolation is provided by a spring-loaded, hydraulically operated valve in each steam line located just outside of containment. The ball-type MSIVs are opened hydraulically and are held open by a mechanical latch. If a pipe ruptures either upstream or downstream of an isolation valve, a main steam line isolation signal causes a trip solenoid to release the mechanical latch, closing the valve by spring force. To assure safety function actuation, all solenoid valves are provided in redundant pairs, powered from separate Class 1E power sources. The MSIVs automatically close on pressure signals in any steam line on a high containment-pressure signal or on a large pressure rate of change in any steam line. The MSIVs can also be closed manually by operator action from the control room. The MSIVs are designed to close in 5 seconds or less and are also designed to stop steam flow from either direction.

A steam line break upstream or downstream of the MSIVs coupled with an MSIV failure to close will not result in a blowdown of more than one steam generator. In the event of a steam line break upstream of an MSIV and a failure of an MSIV to close on an unaffected steam generator, blowdown of the unaffected steam generator through the break is prevented by the closure of the MSIV for the affected steam generator. Blowdown through the turbine and condenser is prevented by closure of the nonseismic Category I turbine stop valves and main steam dump valves which serve as an acceptable backup for this accident in accordance with the guidelines of Issue No. 1 of NUREG-0138, "Staff Discussion of Fifteen Technical Issues Listed in Attachment to November 3, 1976 Memorandum from Director, NRR to NRR Staff."

Three seismic Category I, quality Group B, modulating, electro-hydraulically actuated atmospheric steam dump valves (one for each steam generator main steam line) are provided. One atmospheric dump valve provides modulating pressure control for each steam generator when normal turbine bypass is not available. The valves are normally closed, failed closed (safe position) on loss of power or control signal and have a combined design capacity of 10% of the maximum main steam flow. Two of the three valves provide sufficient decay heat removal for shutdown. The actuators are powered from a Class 1E power supply and can be operated manually from the control room in a loss of offsite power. Controls for two of the atmospheric dump valves are also located on the alternate shutdown panel to provide capability for manually positioning the valves. Provisions have been made to allow local hand hydraulic control should electrical power be unavailable to any of the valves. In addition, a remotely operated residual heat release control valve capable of removing the sensible and reactor decay heat to the atmosphere via the residual heat release header is provided. This safety-related (seismic Category I, quality Group B) valve is manually positioned from the control room and powered from a Class 1E power supply that is redundant to the Class 1E power source for the atmospheric steam dump valves described above. This one valve, which is mounted on the common residual release header, serves all three steam generators through connections on each main steam line upstream of the MSIV, and has twice the capacity of an atmospheric dump valve. This design satisfies the single failure criterion. Check valves ensure that steam may flow to the header, but prevent reverse flow of steam as may occur if a line breaks between a steam generator and MSIV. The atmospheric dump valves and residual heat release valve discharge to atmosphere through a diffuser for noise suppression.

Fifteen seismic Category I, quality Group B safety valves (five on each main steam line) are provided. The safety valves have a combined relief capacity of greater than 100% of the design steam flow. The five safety valves on each line are located outside of containment upstream of the main steam atmospheric dump valve, the turbine bypass valve, the residual heat release valve, and the MSIV in accessible areas of the seismic Category I main steam and feedwater valve building. The MSIVs, residual heat release valve, safety valves, and power-operated atmospheric dump valves will undergo preoperational functional testing at normal design temperature and pressure. MSIV closure times and safety and atmospheric relief valve set points will be verified. Therefore, we conclude that the design of the main steam supply system meets the requirements of General Design Criterion 34, "Residual Heat Removal," by complying with the applicable guidelines of Branch Technical Position RSB 5-1, "Design Requirements of the Residual Heat Removal Systems," and the guidelines of Issue No. 1 of NUREG-0138.

The equipment required to function in order to assure main steam isolation when called upon is protected against the effects of high-energy pipe breaks (refer to Sections 3.6.1 and 3.11 of this SER). This equipment is located in tornado missile-protected structures and is located such that it is not affected by internally generated missiles (refer to Section 3.5.1.1 of this SER). Thus, the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," and the guidelines of Regulatory Guide 1.117, "Tornado Design Classification," Positions C.1 and C.2 are satisfied.

There is no sharing between units of any portion of the main steam supply system; thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable.

Based on the above, we conclude that the main steam supply system from the steam generators through the main steam isolation valves meets the requirements of General Design Criteria 2, 4, and 34 with respect to protection against natural phenomena, missiles, environmental effects, and residual heat removal capability, since the system complies with the guidelines of Regulatory Guides 1.29, Positions C.1 and C.2, and 1.117, Positions C.1 and C.2, relating to the system's seismic classification and protection against tornado missiles, and the guidelines of BTP RSB 5-1 and Issure Number 1 of NUREG-0138 as they relate to the capability to achieve cold shutdown and assure main steam isolation and is, therefore, acceptable. The main steam supply system meets the acceptance criteria of SRP Section 10.3.

10.4.5 Circulating Water System

The circulating water system was reviewed in accordance with Section 10.4.5 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the circulating water system with respect to the applicable regulations of 10 CFR 50.

The nonsafety-related (nonseismic Category I) circulating water system (CWS) provides cooling for the main condenser and is a closed-loop system consisting of four 25 percent capacity pumps, a pump house, circulating water and blow-down piping, and a natural draft cooling tower. The cooling tower provides circulating water to the condenser at 90°F under design conditions. The system is capable of withstanding the pressure transients associated with normal pump startup, shutdown, bus transfer, and a trip of all four pumps following the loss of offsite power.

A potion of the service water system flow is discharged with the CWS. However, failure of the CWS will not affect the safety functions of the service water system or other safety-related equipment as discussed in Section 9.2.1 of this SER. The cooling tower is located sufficiently remote from safety-related structures such that its collapse would not affect any of the BVPS-1 and BVPS-2 seismic Category I structures (including the primary intake structure).

The applicant's analysis of the effects of a postulated failure of the CWS piping or expansion bellows indicates that safety-related structures, systems, and components will not be submerged since the water level will reach grade elevation and flow away from safety-related structures. Safety-related equipment is located above grade elevation. Thus, the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," with regard to flood protection as a result of CWS failure are satisfied.

Based on the above, we conclude that the CWS meets the requirements of General Design Criterion 4 as relates to protection against flooding, and is therefore acceptable. The circulating water system meets the acceptance criteria of SRP Section 10.4.5.

10.4.7 Condensate and Feedwater System

The condensate and feedwater system was review in accordance with Section 10.4.7 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the condensate and feedwater system with respect to the applicable regulations of 10 CFR 50.

The condensate and feedwater system provides feedwater from the condenser to the steam generators and includes the piping components from the condenser hot well, through the condensate pumps, condensate demineralizers, low pressure feedwater heaters, feedwater pumps, high-pressure feedwater heaters, flow control valves, and containment isolation valves to the three steam generators. The system contains three 50% capacity motor-driven condensate pumps and two 50% capacity motor-driven feedwater pumps. The spare condensate pump will auto start on loss of one of the normally running condensate pumps and/or low condensate header discharge pressure.

The condensate and feedwater system is nonsafety related, nonseismic Category I, with the exception of that portion of the feedwater system between the containment isolation valves and the steam generators which is safety related, seismic Category I, and designed to quality Group B criteria. This portion of the system has three safety-related functions as follows; automatically isolate the main feedwater flow to the steam generators following a feedwater isolation signal; provide a barrier against the release of containment atmosphere during a LOCA; and serve as a boundary for assuring that steam generator levels can be maintained when the main feedwater pumps are not available.

Automatic isolation of the main feedwater system is provided when required to mitigate the consequences of a steam or feedwater line break. The hydraulically operated main feedwater isolation valves (one per steam generator) close within 5 seconds on receipt of a feedwater isolation actuation signal. Redundant feedwater isolation is provided by the fail-closed main feedwater regulating valves and bypass valves which serve as an acceptable backup. The isolation valves are located in the main steam and feedwater valve area, a seismic Category I, flood and tornado missile protected structure (refer to Section 3.4.1 and 3.5.2 of this SER). Thus the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Positions C.1 and C.2 have been satisfied. The safety-related auxiliary feedwater system automatically provides flow to the steam generators via the main feedwater lines for decay heat removal upon failure of the condensate and feedwater system. Refer to Section 10.4.9 of this SER for further discussion of the auxiliary feedwater system. Thus, the requirements of General Design Criterion 44, "Cooling Water," are satisfied. The safety-related portions of the system are located in accessible areas and will receive periodic inspection and testing in accordance with the Technical Specifications. Thus, the requirements of General Design Criteria 45, "Inspection of Cooling Water System," and 46, "Testing of Cooling Water System," are satisfied.

The essential equipment is separated from the effects of internally generated missiles and is protected against failures in high energy piping (refer to Sections 3.5.1.1 and 3.6.1 of this SER). Thus, the requirements of General Design Criterion 4, "environmental and Missile Design Bases," are satisfied. No portion of the condensate and feedwater system is shared, therefore, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable.

To reduce the possibility of water hammer in the feedwater system, the feedwater header in the steam generators is provided with J tubes to prevent drainage of water during low steam generator water level. In addition, the feedwater connections to the steam generators utilize a downward turned elbow that does not present a horizontal pipe run immediately upstream of the feedwater nozzles. This arrangement is intended to prevent the formation of steam pockets during steam generator low water level conditions. Thus, the requirements of General Design Criterion 4 and the guidelines of Branch Technical Position ASB 10-2 "Design Guidelines for Water Hammer in Steam Geerators with Top Feeding Designs" are satisfied except as noted below. [The applicant's response to our request for performance of a test to demonstrate that the potential for feedwater water hammer has been adequately reduced is unacceptable. It is our position that a test is necessary in order to verify the effectiveness of the design provisions. Therefore, we will require a commitment for such a test. The test should be conducted at system conditions as close as practical to those experienced during normal plant operations. Automatic initiation of the auxiliary feedwater system should be allowed to occur following the tripping of the main feedwater pumps. The applicant should observe and record the initial conditions and the transient that follows. The applicant should also provide physical drawings which illustrate the system waterhammer prevention design features.]

[Based on the above, we conclude that except as noted, the safety-related portion of the condensate and feedwater systems meets the requirements of General Design Criteria 2, 4, 44, 45 and 46 with respect to its protection against natural phenomena, missiles and environmental effects, isolation capability for decay heat removal functions, inservice inspection, and testing, and meets the guidelines of Regulatory Guide 1.29 Positions C.1 and C.2 and Branch Technical Position ASB 10-2 with respect to seismic classification and water hammer prevention features and is, therefore, acceptable. The condensate and feedwater systems meets the acceptance criteria of SRP Section 10.4.7 except as noted above. We will report resolution of our concern in a supplement to this SER.]

10.4.9 Auxiliary Feedwater System

The auxiliary feedwater system was reviewed in accordance with Section 10.4.9 of the Standard Review Plan (SRP), NUREG-0800. An audit review of each of the areas listed in the "Areas of Review" portion of the SRP section was performed according to the guidelines provided in the "Review Procedures" portion of the SRP section. Conformance with the acceptance criteria formed the basis for our evaluation of the auxiliary feedwater system with respect to the applicable regulations of 10 CFR 50.

We reviewed the auxiliary feedwater system (AFWS) against the acceptance criteria of SRP Section 10.4.9 as follows:

(1) General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," as related to structures housing the system and the system

itself being capable of withstanding the effects of earthquakes. Acceptability is based on meeting Position C.1 of Regulatory Guide 1.29 for safety-related portions and Position C.2 for nonsafety-related portions.

(2) General Design Criterion 4, "Environmental and Missile Design Bases," with respect to structures housing the system and the system itself being capable of withstanding the effects of external missiles and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks. The basis for acceptance for this criterion is set forth in SRP Sections 3.5 and 3.6.

(3) General Design Criterion 5, "Sharing of Structures, Systems and Components," as related to the capability of shared systems and components important to safety to perform required safety functions.

(4) General Design Criterion 19, "Control Room," as related to the design capability of system instrumentation and controls for prompt hot shutdown of the reactor and potential capability for subsequent cold shutdown. Acceptance is based on meeting BTP RSB 5-1, with regard to cold shutdown from the control room using only safety-related equipment.

(5) General Design Criteria 34, "Decay Heat Removal," and 44, "Cooling Water," to ensure:

(a) the capability to transfer heat loads from the reactor system to a heat sink under both normal operating and accident conditions

(b) redundancy of components so that under accident conditions the safety function can be performed assuming a single active component failure (this may be coincident with the loss of offsite power for certain events)

(c) the capability to isolate components, subsystems, or piping, if required, so that the system safety function will be maintained.

In meeting these criteria, the recommendations of NUREG-0611, "Generic Evaluation of Feedwater Transients and Small Break Loss of Coolant Accidents in Westinghouse Designed Operating Plants," shall also be met. An acceptable AFWS should have an unreliability in the rate of 10^{-4} to 10^{-5} per demand based on an analysis using the methods and data presented in NUREG-0611.

(6) General Design Criterion 45, "Inspection of Cooling Water System," as related to design provisions made to permit periodic inservice inspection of systems, components, and equipment.

(7) General Design Criterion 46, "Testing of Cooling Water System," as related to design provisions made to permit appropriate functional testing of the system and components to ensure structural integrity and leaktightness, operability and performance of active components, and capability of the integrated system to function as intended during normal, shutdown, and accident conditions. In meeting this criterion, the Technical Specifications should specify that the monthly AFWS pump test shall be performed on a staggered test basis to reduce the likelihood of leaving more than one pump in a test mode following the tests.

The following evaluation discusses the implementation of these acceptance criteria and follows the order of the Review Procedures of SRP Section 10.4.9. This evaluation also incorporates our review of the applicant's response to Item II.E.1.1, "Auxiliary Feedwater System Reliability," of NUREG-0737. This includes:

(1) an evaluation against the deterministic criteria of the SRP

(2) an evaluation against the generic recommendations of NUREG-0611

(3) an evaluation of system reliability based on the applicant's reliability study.

(4) an evaluation of the design basis for the flow capacity for the system.

The auxiliary feedwater system (AFWS) is designed to supply an independent source of water to the secondary side of the steam generators when the normal feedwater system is not available, thereby maintaining the heat sink capabilities of the steam generators. The AFW system is an engineered safety feature system which is relied upon to aid in preventing core damage in the event of transients such as loss of normal feedwater, a secondary system pipe rupture, or small break LOCA. The system consists of three redundant, safety-related essential trains each with its own pump, associated valves, piping, controls, and instrumentation. Each AFW pump is capable of supplying feedwater to all three steam generators. Two "half capacity" motor-driven pumps are provided, each with a design flowrate of 375 gpm at 2760 feet TDH including recirculation flow of 25 gpm and powered from separate onsite emergency diesel generators. A "full capacity" turbine-driven pump is also provided with a design flowrate of 750 gpm at 2760 feet TDH including recirculation flow of 50 gpm. The controls for the turbine-driven AFW pump are powered completely independent of the motor-driven AFW pumps and independent of ac power. Each of the AFW supply lines to the steam generator contains a check valve, motor-operated isolation valve, and flow control valve. Steam for the AFW pump turbine is supplied from each of the steam generators (A, B, and C) upstream of the main steam isolation valves. AFW flow to the steam generators is limited by flow venturies located in each AFW line. These venturies are sized to restrict the flow to a depressurized steam generator while assuring sufficient flow for decay heat removal to the two remaining intact steam generators.

BVPS-2 has its own AFWS with the water supply provided by the primary plant demineralized water storage tank (PPDWST) through three suction lines. Each line contains two locked open manually operated isolation valves. Since the AFWS is not shared with BVPS-1, the requirements of General Design Criterion 5 are not applicable.

We have reviewed the AFWS design to verify its acceptability with respect to its classification and operating characteristics. Minimum performance requirements for the AFWS have been identified and are sufficient for the various functions of the system. This is discussed in more detail in this SER section.

Adequate interface isolation of the safety-related AFWS from nonsafety-related systems is included in the system design. These interfaces occur at (1) the main feedwater lines, (2) the PPWST, and (3) the chemical addition system. AFW supply to the steam generators enter the main feedwater line downstream of all other connections. Motor-operated, seismic Category I, quality Group B, redundant isolation and check valves are provided in the main feedwater line to protect the AFW system from failures in the nonseismic Category I portions of the main feedwater lines. The PPDWST is seismic Category I, quality Group C (refer to Section 9.2.6 of this SER). All nonseismic Category I piping connections to the PPDWST are above the dedicated AFW system water volume. All piping and instrumentation, including redundant level indicators connected to the dedicated water volume in PPDWST, are seismic Category I. Interfaces with the chemical addition system are provided with seismic Category I normally closed manual valves and check valves. Each AFW pump is provided with a seismic Category I recirculation control valve, which is located on the discharge piping that recirculates back to the PPDWST. The above features provide sufficient isolation to ensure that system function is not impaired in the event of failure of a nonessential component. Therefore, we conclude that the AFWS meets the isolation requirements of General Design Criteria 2 and 44 and the guidelines of Position C.2 of Regulatory Guide 1.29.

The AFWS is designed to seismic Category I, quality Group C criteria from the PPDWST up to but not including the electrohydraulic (E/H) operated control valves. The E/H-operated control valves, downstream check valves, and the piping from the control valves to the steam generator are designed to seismic Category I, quality Group B standards. The AFWS is located within the seismic Category I safeguards building and containment building and is thus protected against the effects of natural phenomena and tornado missiles. The PPDWST is located outside, but is protected against the effects of tornadoes and missiles by a seismic Category I concrete enclosure. A portion of the AFW suction piping is routed underground from the PPDWST to the AFW pumps, thereby providing protection from tornado missiles. The turbine drive for the turbine-driven AFW is seismically qualified to function during the SSE. Therefore, we conclude that the AFWS meets the requirements of General Design Criterion 2 regarding protection against natural phenomena and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2 with respect to its seismic classification.

Provisions for AFWS testing and inspection are included in the design. Each AFWS pump is equipped with a recirculation line to the PPDWST for periodic functional testing. Local manual realignment of valves is not required to accomplish this testing. Continuous recirculation during pump operation is provided through a fixed orifice. When one AFW pump train is being tested, the other two trains are available for automatic operation. Periodic surveillance testing of the essential pumps and their associated flow trains is identified in the Standard Technical Specifications. The applicant has committed to incorporate in the proposed plant Technical Specifications a statement that one essential AFWS pump train may be inoperable for no more than 72 hours. If this time is exceeded, the unit affected must be placed in hot standby within 6 hours and hot shutdown within an additional 6 hours. The AFW system is tested each month for pump capacity and valve position and each 18 months for automatic start capability. Further, the applicant has committed to incorporate in the plant Technical Specifications an AFW flow path verification test where water is pumped from the primary water source to the steam generators before startup after any cold shutdown of 30 days or longer. Based on the applicant's commitments, we conclude that the AFW system meets the requirements of General Design Criterion 46 and the recommendations of NUREG-0611 with respect to functional testing and surveillance requirements.

The AFW components are located in areas that are accessible during normal plant operation to permit periodic inservice inspection. The applicant has committed to provide a second (independent) operator verification of proper AFWS valve position following restoration of an AFWS train to service after periodic testing or maintenance. Therefore, we conclude that the AFWS meets the requirements of General Design Criterion 45 and the recommendations of NUREG-0611 regarding provisions for inservice inspection.

The AFW trains are not used during startup and shutdown, therefore are not designed as high-energy lines as prescribed in the criteria of SRP Sections 3.6.1 and 3.6.2. Separate cubicles are provided for each AFW pump in order to prevent possible internally generated missiles from damaging more than one pump. While the separate cubicle enclosure for the turbine-driven pump protects the motor-driven pumps from potential missiles originating from the turbine-driven pump, the applicant has not provided the results of an analysis which shows that potential missiles from the turbine-driven AFW pump cannot damage other safety-related equipment. Further discussion regarding internally generated missile protection is contained in Section 3.5.1.1 of this SER. Protection against the effects of pipe breaks is discussed further in Section 3.6.1 of this SER. Environmental qualification of AFWS components with respect to pipe breaks is discussed in Section 3.11 of this SER. Thus, the requirements of General Design Criterion 4 regarding protection against missiles and pipe breaks are satisfied.

The AFWS functions automatically as required in the event of a loss of offsite power. The heat transfer path from the steam generators under this condition is to the atmosphere via the atmospheric relief valves (see Section 10.3.1 of this SER for further discussion). The turbine-driven pump functions independently of any ac power as discussed subsequently in this SER section and thus is not affected by a loss of offsite power. Power for the motor-driven pumps is normally provided by the two onsite emergency diesel generators. The power supply train for each pump is physically separated from that of the other pump. Driving steam for the turbine-driven pump is provided from either the A, B, or C steam generator main steam lines upstream of the main steam isolation valves and is discharged to the atmosphere. Each steam supply line is provided with an air piston-operated valve that opens on a signal to start the turbine-driven pump. Redundant control systems are provided to ensure the opening of each valve on a turbine-driven pump start signal. Any power or air failure will result in the valve failing open. A check valve is provided in each steam supply to prevent flow reversal. Each AFW pump discharge is provided with a normally open motor-operated isolation valve, a normally open electro-hydraulic-operated control valve, and a check valve in the individual feedlines to each steam generator. The discharge from the AFW pump also has a loop for full-flow pump testing. Self-regulating recirculation flow control valves are provided to ensure individual pump minimum flow when needed during operation. Therefore, we conclude that the requirement of General Design Criteria 34 and 44 and the recommendations of NUREG-0611 with respect to the ability of the AFWS to transfer decay heat from the reactor coolant system under a loss of offsite power are satisfied.

The AFWS is designed to accommodate a single failure in any active system component without loss of function. The AFWS consists of three redundant trains, a "100-percent capacity" turbine-driven train and two "half-capacity" motor-driven trains, each supplying all three steam generators. Each "half-capacity" train provides sufficient flow for deay heat removal as discussed further is this SER section. Each AFW pump is supplied by separate suction lines from the PPDWST through locked open manual valves. Thus, adequate feedwater to an intact steam generator is assured in the event of a postulated design-basis accident concurrent with a single failure. Adequate isolation is provided for the AFWS from nonessential systems (see above). Therefore, we conclude that the AFW system meets the requirements of General Design Criteria 34 and 44 and the recommendations of NUREG-0611 with respect to single failure.

Adequate AFW flow is ensured to the steam generators in the event of the loss of offsite and emergency onsite ac power by relying on the safety-related diverse turbine-driven pump subsystem, which can perform its safety function independent of ac power for at least 2 hours. Loss of ac power will not adversely affect the position of motor-operated valves in the turbine-driven pump subsystem. All electrically operated valves in the turbine-driven pump discharge path to the A, B, and C steam generators are normally open and fail as is on loss of ac power. Therefore, we conclude that the AFWS meets the requirements of General Design Criteria 34 and 44, the guidelines of BTP ASB 10-1, and the recommendations of NUREG-0611 with regard to AFWS power diversity.

The motor-driven pumps will automatically start and provide the minimum required feedwater flow within 1 minute following any of the following conditions:

1) low-low steam generator level in two out of three steam generators

2) loss of both main feedwater pumps

3) initiation of a safety injection signal

4) loss of station offsite power (main feed pumps tripped)

5) failure to start turbine-driven AFW pump.

The turbine-driven pump will automatically start and provide the minimum required feedwater flow within 1 minute following either of these conditions:

1) low-low steam generator level in any steam generator
2) manual start (from the control room on emergency shutdown panel
3) reactor coolant pump buses under voltage (2 out of 3 logic)

Flow rate indication and control of auxiliary feedwater to each steam generator are achieved by venturi and orifice flowmeters with safety-related indication and remote manual control from the control room. Further discussion of automatic AFWS intiation and flow indication including compliance with the recommendation of Item II.E.1.2 of NUREG-0737 is contained in Section 7.3 of this SER. The manual capability to intiate and control the AFWS pumps/valves and isolate an AFWS train is provided in the control room and at the emergency shutdown panel using safety-related Class IE equipment. This manual capability exists even after automatic system actuation. In addition, local manual control at the individual component is also available. Therefore, we conclude that the AFWS provides adequate instrumentation and control for prompt initiation of a shutdown using safety-related equipment in accordance with the requirements of General Design Criterion 19, the guidelines of BTP RSB 5-1, and the recommendations of NUREG-0611.

The applicant has described the design of the AFWS to prevent excessive pump runout following a main steam or feedwater line break (steam gnerator depressurization) and still maintain the minimum required AFWS flow (350 gpm) to at least two intact steam generators. Flow control valves and a flow-limiting venturi are provided on each AFWS supply line to each steam generator to limit the AFW flow to a depressurized stream generator. Operator action can then be taken within 10 minutes to terminate flow to the depressurized steam generator by manually closing the AFWS isolation valves from the control room. AFWS flow is not throttled to avoid the occurrence of waterhammer because system design provisions minimize the possibility of such a condition (refer to SER Section 10.4.7 for further discussion). Therefore, we conclude that the AFWS meets the requirements of General Design Criteria 34 and 44 with respect to its ability to transfer heat under accident conditions and provide isolation to ensure system function. The AFWS also meets the recommendations of NUREG-0611 concerning throttling for waterhammer prevention.

Each AFW pump is designed to provide sufficient flow necessary for residual heat removal over the entire range of emergencies requiring AFWS function in accordance with the conservatisms assumed in the accident analysis. These emergencies include the following accident/transient conditions:

1. loss of main feedwater
2. loss of offsite power
3. secondary system pipe rupture
4. cooldown following steam generator tube rupture
5. small break loss-of-coolant accident

These conditions are discussed further in Section 15 of this SER. A minimum dedicated volume in the PPDWST of 140,000 gallons of water is reserved for the AFWS by Technical Specification. This volume ensures a cooldown of the reactor coolant system to the residual heat removal system cut-in temperature (350°F) in 7 hours (3 hours in hot standby and 4 hours for cooldown) assuming no makeup to the PPDWST. The PPDWST is provided with connections to the 600,000-gallon demineralized water storage tank which is used for normal makeup and makeup during normal conditions. The connection between the two tanks is provided above the 140,000-gallon minimum water level in the PPDWST. No nonsafety-related piping is directly connected to the PPDWST below the dedicated water volume. Safety-related full-range redundant-level transmitters are provided on the tank. Annunciation is provided in the control room for PPDWST high and low levels. The PPDWST is equipped with a chemical addition system for maintaining proper water quality. In addition, the applicant committed to develop procedures for transferring to the service water system, which serves as an additional safety-related backup long-term source of AFW for the steam generators (refer to SER Section 9.2.1). Therefore, we conclude that the AFWS meets the decay heat removal requirements of General Design Criteria 34 and 44, the guidelines of BTP RSB 5-1, and the recommendations of NUREG-0611.

The generic recommendations of NUREG-0611 as they relate to improvements in AFW design, procedures, and Technical Specifications have been discussed in the preceding paragraphs. In addition, the applicant has committed to perform a 48-hour endurance test on each AFW pump before initial fuel load. This commitment is acceptable and meets the recommendations of NUREG-0611.

NUREG-0737, Item II.E.1.1, requires that a reliability analysis of the AFWS be performed. The applicant has provided the results of the evaluation for the following transients:

(1) Loss of main feedwater with offsite power available - overall system unavailability 8.7×10^{-6}.

(2) loss of main feedwater due to loss of offsite power - overall system unavailability 9×10^{-6}.

The applicant has not documented the AFWS reliability for loss of main feedwater and loss of all ac power (station blackout) as requested in the March 10, 1980 NRC generic letter concerning Item II.E.1.1 of NUREG-0737. Further, our review of the applicant's AFWS reliability analysis is not yet complete, and, therefore, we cannot confirm the applicant's results for the above two postulated transient scenarios.

The applicant has submitted the design basis for the AFWS flow requirements. The design bases were requested as part of NUREG-0737 Item II.E.1.1 and detailed in Enclosure 2 of the NRC's March 10, 1980 generic letter. We have reviewed the applicant's response regarding the design basis for the AFWS flow requirements and conclude that the applicant's design basis for AFWS flow requirements is acceptable.

Based on our review, we conclude that the AFWS complies with the requirements of General Design Criteria 2, 19, 34, 44, 45, and 46 with respect to protection against natural phenomena and environmental effects, capability to shut down the plant from the control room, capability to remove sufficient decay heat for safe shutdown and cooling water capability inservice inspection, and functional testing, the guidelines of Regulatory Guide 1.29, BTP ASB 10-1 and RSB 5-1 concerning seismic classification, power diversity and design of decay heat removal systems. However, further information is required to confirm compliance with GDC 4 as it relates to protection against internally generated missiles. In addition, our review of the applicant's AFWS reliability study to confirm compliance with the recommendation of NUREG-0737 Item II.E.1.1 is not complete. Therefore, we cannot conclude that the AFWS meets the acceptance criteria of SRP Section 10.4.9. We will report resolution of the above concerns in a supplement to this SER.