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

(9)

NOV 13 1984

Docket Nos. 50-424/425

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: DRAFT SAFETY EVALUATION REPORT INPUT FOR VOGTLE, UNITS 1 AND 2 - AUXILIARY SYSTEMS BRANCH

The enclosed Draft Safety Evaluation Report (DSER) input covers those portions of the Vogtle, Units 1 and 2 Final Safety Analysis Report (FSAR) for which the Auxiliary Systems Branch has primary responsibility. This evaluation is based on our review of the Vogtle FSAR up to and including Amendment 10.

The following areas have not been resolved and require additional information or design changes to be provided by the applicant. We will report on the resolution of these open items in the Final SER or supplements thereto.

1. Section 3.4.1 - Flood Protection

   a. The design basis flood level is still being pursued by the Environmental and Hydrologic Engineering Branch.

   b. The applicant must provide a means of monitoring the position of watertight doors and establish a routine surveillance for inspection of their capability.

2. Section 3.5.2 - Systems, Structures, and Components To Be Protected From Externally Generated Missiles - The applicant has not provided sufficient information to justify tornado missile protection for the cooling tower fans which are subject to vertical (lob shot) missiles.

3. Section 3.6.1 - Protection Against Postulated Pipe Breaks Outside Containment

   a. The applicant's steam line break analysis did not consider the production of superheated steam and the resulting effects on the environment. This is an oversight in the analyses for all Westinghouse plants.

Contact:
W. LeFave
X29470

8411210098 XA

90

b. The applicant's flooding analysis of a circulating water system failure in the turbine building is based on the "critical" crack size. Since this is not a seismically designed or supported piping system we require that a full break be assumed due to a seismically induced event. (This open item is also identified in Section 10.4.5, "Circulating Water System."

4. Section 9.1.5 - Overhead Heavy Load Handling System - Our consultant, EG&G is currently evaluating the system against the guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

5. Section 9.3.3 - Equipment and Floor Drainage System - The applicant has not completed the flooding analyses to determine which areas will require watertight doors to protect against flooding.

6. Section 9.4.5 - Engineered Safety Features Ventilation Systems - The applicant has not demonstrated that the diesel generator ventilation systems adequately protect the electrical equipment from the effects of dust and particulate material accumulation.

7. Section 10.4.9 - Auxiliary Feedwater Systems - Our consultant, Brookhaven National Laboratory, has not yet completed its review of the AFW reliability study performed by the applicant. Discussions with the consultants indicate no further information is required to complete the review.

The applicant also will not provide responses to our request for additional information regarding post-fire safe shutdown until April 1985. We will provide our safety evaluation of this item to the Chemical Engineering Branch for the final SER input when the information is provided and our review is complete.

Our SALP in also enclosed in accordance with Office Letter 44.

L S Rubenstein

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

Enclosure and cc:
See next page

DRAFT SAFETY EVALUATION REPORT
VOGTLE, UNITS 1 & 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 Part 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 flood protection design included all systems and components whose failure due to flooding could prevent safe shutdown of the plant or result in uncontrolled release of significant radioactivity.

The nominal finished grade level for the plant is at elevation 219.5 feet Main Sea Level (MSL) and the minimum elevation of entrances to all safety-related structures including the ultimate heat sink pump house are at 220.0 feet MSL. These elevations are well above the probable maximum flood (PMF) level including wind and wave runup of 168 feet MSL which is caused by the probable maximum precipitation (PMP) as evaluated in Section 2.4.3 of the SER. [However, the design basis flooding level (DBFL) as defined in Regulatory Guide 1.102 "Flood Protection for Nuclear Power Plants," has not yet been established as described in Section 2.4 of this SER. We cannot make a determination regarding Regulatory Guides 1.59 "Design Basis Floods for Nuclear Power Plants," and 1.102, ~~"Flood Protection for Nuclear Power Plants,"~~ until the DBFL has been established.]

At our request the applicant in Amendment 10 to the FSAR provided the results of an analysis to show that site flooding due to a natural draft cooling tower basin failure or a circulating water system failure in the plant yard will not cause flooding or damage to safety-related equipment and will not have any erosion effects on underground safety-related piping and tunnels. The applicant concludes the water will be channeled away from essential structures and flow to the yard drainage system. We have reviewed the results of the analysis and concur with the applicant's conclusions. Refer to Section 2.4 for a discussion of the site drainage capability.

The applicant has provided the results of analyses that show flooding caused by the failure of nonseismic Category I tanks, vessels and other process equipment in both the outside areas and inside seismic Category I buildings will not result in failure of safety-related equipment required for accident mitigation or safe plant shutdown. We have reviewed the applicant's method for performing these analyses and the methods of protecting safety-related equipment from the effects of flooding due to these equipment failures and conclude they are acceptable. Flood protection from the effects of piping failures outside containment are evaluated in Section 3.6.1 of this SER. ×

[In response to our request the applicant stated that watertight doors are not indicated or alarmed in the control room and that the open/close position of the doors will be controlled by administrative procedures. For those watertight doors that are specifically required for protection against internal flooding we require the applicant to provide positive indication of the position of the doors and to describe the program to be followed to assure the doors functional capability (surveillance requirements) over the life of the plant. The applicant should also propose appropriate technical specifications regarding the operability of the doors.]

[Because the DBFL has yet to be adequately established and is still being evaluated and since the applicant has not adequately addressed our concerns regarding watertight doors, we cannot make a determination with respect to compliance with General Design Criterion 2, ~~"Design Bases for Protection Against Natural Phenomena,"~~ and Regulatory Guides 1.59 and 1.102. We, therefore, ×

cannot reach a conclusion regarding the plant design meeting 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 for 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 acceptance criteria for the design of the facility for providing missile protection includes meeting Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles." The review of 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 unacceptable radiological consequences or that are required for safe plant shutdown, against postulated missiles associated with plant operation. The missiles considered in this evaluation include those missiles generated by rotating or pressurized (high-energy fluid system) equipment. Potential gravitational missiles have been precluded by adequately supporting equipment to prevent failures caused by seismic events in areas where the possibility of interaction with seismic Category I structures, systems, or components exists. Gravitational missiles due to the failure of cranes or hoists are evaluated in Sections 9.1.4 and 9.1.5 of this SER.

Potential high-energy missile sources evaluated by the applicant included temperature detectors, auxiliary fittings such as thermocouple wells, pressure gages, vents, drains and test connections, valve bonnets, valve stems, nuts, bolts and nut/bolt combinations. The evaluation was performed on the basis that a single failure could result in their becoming potential missiles. The applicant has verified that by design either the potential missiles are not credible or essential equipment is protected by complete separation and compartmentalization.

Potential rotating missile sources evaluated by the applicant included pump impellers, air handling unit fan blades, room cooler fan blades, and the turbine disk for the auxiliary feedwater (AFW) turbine driven pump. The evaluation was performed on the basis that all rotating components that are operated during normal operating plant conditions were considered as potential missile sources and the energy of a rotating part associated with component failure is assumed to occur at 120 percent overspeed. The only instance where specific missile protection ~~had to be provided~~ was for the turbine drive AFW pump. For all other cases, essential equipment is protected by missiles from a redundant train by complete separation and compartmentalization.

~~For~~ both high energy and rotating ~~missile~~ sources ~~components impacted by missiles~~ were analyzed to confirm that the ability to safely shut down the plant is not compromised. The analysis considered the effects of the most limiting single active failure concurrent with the missile.

Based on our review, we conclude that the design of the facility is in conformance with General Design Criterion 4 as it relates to protection against internally generated missiles outside containment since the applicant has identified potential missile sources and has shown that essential structures, systems and components are protected by separation and compartmentalization or specialized missile barriers. We, therefore, conclude the design is acceptable and meets the acceptance criteria of SRP Section 3.5.1.1.

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.

All 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 components (high-energy fluid system) failures, and gravitational effects.

Potential gravitational missiles have been precluded by adequately supporting equipment to prevent failures as a result of seismic events in areas where the possibility of interaction with seismic Category I structures, systems or components exists. Gravitational missiles due to the failure of cranes or hoists are evaluated in Sections 9.1.4 and 9.1.5 of this SER.

The applicant considered the following for potential missiles from pressurized high-energy fluid systems: control rod drive mechanism (CRDM) housing plugs, CRD shaft, CRD shaft and mechanism, valve bonnets, temperature and pressure sensors, instrumentation wells, pressurizer heaters, and the pressurizer relief tank rupture discs. The applicant has performed analyses to verify that the design of the above components prevents the generation of missiles as a result of a single failure, or if generated, the missiles either have insufficient energy to cause unacceptable damage or adequate compartmentalization, separation or barriers have been provided for protection of safety-related equipment. The only barrier specifically designed as a missile barrier is the intergrated head missile shield to protect against CRDM missiles.

With respect to potential rotating missile sources inside containment, the applicant has analyzed the potential for the reactor coolant pump flywheel to become a missile source as a result of flywheel failure in accordance with the guidelines of Regulatory Guide 1.14, "Reactor Coolant Pump Flywheel Integrity."

Refer to Section 5.4 of this SER for further discussion of reactor coolant pump flywheel integrity and compliance with Regulatory Guide 1.14. The rotor and impeller have also been analyzed as potential missiles and it has been determined that they will be retained by the heavy stator frame or the pump casing.

We have reviewed the applicant's analysis and concur with the applicant's assumptions and conclusions made for potential missile sources inside containment.

Based on our review, we conclude that the design of the facility is in conformance with General Design Criterion 4 as it relates to protection against internally generated missiles inside containment since the applicant has identified potential missile sources and has shown that essential structures, systems and components are protected by separation and compartmentalization, equipment orientation or missile barriers. We, therefore, conclude the design is acceptable and meets the acceptance criteria of SRP Section 3.5.1.2.

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 except as noted below. Conformance with the acceptance criteria, except as noted below, formed the basis for our evaluation of the tornado missile spectrum with respect to the applicable regulations of 10 CFR Part 50.

The portions of the "Review Procedures" concerning the probability per year of damage to safety-related systems due to missiles was not used in our review. Our review for this section of the SRP is concerned with establishing the missile spectrum, not with calculating the probability of damage. 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 and the spectrum of missiles for a tornado Region I site as identified in Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants" and the guidelines of the Standard Review Plan, Section 3.5.1.4.

The applicant has evaluated the facility with respect to those missiles given for Spectrum A of SRP Section 3.5.1.4, Revision 2. The spectrum includes the weight, velocity, dimensions and the height attained for each selected missile. 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," Positions C.1 through C.3 is provided in Section 3.5.2 of this SER. A discussion of the adequacy of barriers and structures to withstand the effects of the identified tornado missiles is provided in Section 3.5.3 of this SER.

Based on our review of the tornado missile spectrum identified in the applicant's FSAR, 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, Positions C.1 and C.2 with respect to identification of missiles generated by natural phenomena.

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. X

General Design Criterion 2, "Design Bases 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 Vogtle site is located in tornado Region I as identified in Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants." The tornado missile spectrum is discussed in Section 3.5.1.4 of this SER.

All safety-related structures, systems and components requiring protection from externally generated missiles have been identified in the FSAR. All safety-related structures are designed to withstand postulated tornado generated missiles without damage to safety-related equipment. Safety-related piping and electrical cables that traverse between the safety-related tornado missile resistant buildings are located in underground concrete tunnels which are also tornado missile resistant for the spectrum of missiles considered in the design. An exception to this ~~are~~ is the diesel generator fuel oil lines between the storage tanks and the diesel generator buildings. The transfer lines are adequately protected from tornado generated missiles by locating them ten feet underground. Safety-related HVAC openings are protected from tornado missiles by concrete barriers which prevent missile entry. Spent fuel is protected against tornado missiles in accordance with Position C.2 of Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," since the spent fuel pool is located within the tornado missile protected fuel building.

The ultimate heat sink for each unit has two mechanical draft cooling towers with four fans in each tower. The fans are not provided with vertical missile protection but are inherently protected against direct horizontal missiles by the towers' concrete construction. Three of four fans in either tower are required to operate to provide adequate heat rejection capability. The minimum height a missile would have to obtain to vertically enter the cooling tower and strike a fan is approximately 45 feet above grade which eliminates the heavier missiles such as the utility pole and automobile from consideration. Each fan has its own opening (approximately 25 feet in diameter) such that missiles entering an opening could only damage one fan. The applicant performed a detailed probabilistic study using site specific historical data for tornado occurrence frequency and lift/transport models.

The applicant states that the study used site-specific historical records for the tornado occurrence frequency and lift/transport models previously reviewed and accepted by the NRC. In order to verify the applicant's conclusions reached as a result of their study, the applicant should provide the details of the analysis, including the methods used and assumptions made. The applicant should include a single failure analysis, and as a contingency, the cooling tower capabilities for performing a shutdown following a loss of offsite power without the fans operating should be discussed. Until we have this additional information we cannot conclude that ~~The study was conservative in that one of the two towers was assumed to be out of service for maintenance. The study demonstrated that the frequency of tornado missiles disabling the ultimate heat sink (i.e., two or more fans in the operable tower struck by missiles) is much lower than 10-7 per year. Based on our review of the design and on the conservatisms used in the applicant's probabilistic analysis we conclude that additional tornado missile~~ protection for the cooling tower fans is not required and that the facility design meets the guidelines of Regulatory Guide 1.27 "Ultimate Heat Sink," Position C.2 concerning tornado missile protection. Similarly, ~~since the~~ we cannot conclude that the applicant has provided tornado missile protection for all the structures, systems and components identified in the Appendix to Regulatory Guide 1.117 "Tornado Design Classification." therefore, we cannot make a determination with respect to ~~the facility design satisfies Positions C.1 through C.3 of Regulatory Guide 1.117. The design therefore meets~~ the requirements of General Design Criteria 2 and 4. Refer to Section 3.5.1.3 of this SER for a discussion of protection against low-trajectory turbine missiles including compliance with Regulatory Guide 1.115 "Protection Against Low-Trajectory Turbine Missiles."

Based on the above, we cannot conclude that the applicant's list of 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 regarding natural phenomena and missile protection, and we cannot conclude that the provisions are in accordance with the guidelines of Regulatory Guides ~~DG~~ 1.27 and 1.117 concerning protection of safety-related plant features, specifically ~~including stored fuel and~~ the ultimate heat sink, from tornado missiles. We therefore cannot conclude the design meets the acceptance criteria of SRP Section 3.5.2. ~~and is acceptable.~~

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 staff's guidelines for meeting the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," concerning protection against postulated piping failures 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 identified all high and moderate energy piping systems in accordance with these guidelines and also has identified those systems requiring protection from postulated piping failures.

The applicant analyzed the effects of high and moderate energy piping failures on safety-related structures, systems and components. Protection against these breaks is provided by means of physical separation, enclosure in suitably designed structures or compartments, drainage systems, pipe whip restraints, equipment shields, and environmental equipment qualification as required. The primary means of protection is by separation and compartmentalization. For high energy pipe breaks and moderate energy cracks in other than dual-purpose seismic Category I moderate energy essential systems the most limiting single-active failure was also considered and it was shown that safe-shutdown was not effected. Dual purpose moderate-energy essential systems are those required to operate during normal plant conditions as well as to shut down the reactor and mitigate the consequences of the piping failure. ×

[The main steam and feedwater systems up to the first restraint outside containment are classified as part of the break exclusion boundary as defined in item B.1.6 of Branch Technical Position MEB 3-1 "Postulated Breaks and Leakage Locations in Fluid System Piping Outside Containment." In accordance with ASB 3-1 the applicant provided the results of an analysis of a nonmechanistic break in these lines to determine the environmental effects in the compartments housing the main steam and feedwater lines. ~~Our consultant, Pacific Northwest Laboratory, is currently performing an independent analysis~~ The applicant's analysis of a steam line break did not take into account the possibility and effect of superheated steam conditions as a result of the break. This has been identified by Westinghouse as a

generic deficiency in their steam line break analysis. The applicant should revise the steam line break analysis to address this concern, including the adverse environmental effects on equipment due to the higher temperatures.]
~~of a break in this area to determine the adequacy of the applicant's methodology for performing the analysis.]~~

With regards to moderate energy systems the applicant indicated that only leakage cracks were assumed in nonseismic moderate energy systems. To verify adequate protection against flooding events due to failure of nonseismic Category I moderate energy piping systems we required the applicant to assume a complete failure of any nonseismic moderate energy system due to a seismic event. In Amendment 9 to the FSAR, the applicant stated that all nonseismic Category I piping systems in safety-related areas were seismically supported. Based on this we concur with the applicant's assumption that only cracks, not ruptures, need be assumed for these seismically supported moderate energy systems.

[In Amendment 10 to the FSAR the applicant provided an analysis of a circulating water system failure based on a critical crack size as defined in MEB 3-1. Since the circulating water system is not seismically supported nor has it been demonstrated that a catastrophic failure of the system cannot occur as a result of a seismic event, the applicant must provide a flooding analysis of a circulating water system double-ended rupture, not just a leakage crack. This analysis must be completed in order to make a determination with respect to General Design Criteria 2 "Protection Against Natural Phenomena," and 4.]

In Section~~s~~ 3.6.2 and Appendix 3F of the FSAR, the applicant has provided the results of their analysis for all pipe breaks, high- and moderate-energy, for the auxiliary building, level C and the safety-related pump rooms on levels B & D of the auxiliary building. A similar analysis has been performed for each plant area and is available for review. Based on our review of the results of the analysis in the FSAR we conclude that the applicant has performed the analyses in accordance with our Branch Technical Position ASB 3-1. X

[Based on the above we cannot make a determination with respect to General Design Criteria 2 and 4 until the applicant addresses the superheated steam concern as a result ~~our consultant completes the independent evaluation of the effects~~ of a break in ~~the~~ a main steam line ~~and feedwater areas~~ and ~~the applicant~~ demonstrates to our satisfaction that a rupture in the circulating water system will not prevent safe plant shutdown.]

4.6 Functional Design of Reactivity Control Systems

The reactivity control systems were reviewed in accordance with Section 4.6 of NUREG-0800 (SRP). 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 reactivity control systems with respect to the applicable regulations of 10 CFR 50.

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 to which the rod cluster control assemblies are attached. The control rod drive mechanisms are discussed and evaluated in Section 3.9.4 of this SER. 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 on these features.

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 automatically injected by the SIS and the CVCS in the event of a LOCA, steamline break, or feedwater line break. thereby complying with the requirements of General Design Criterion 29.

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 of a rod cluster control assembly is considered in transient and accident analyses that include the most reactive rod cluster control assembly stuck out of the core. Analysis of accidental withdrawal of a rod cluster control assembly is found to have acceptable results. This conforms to the requirements of General Design Criteria 23 and 25. Refer to Sections 4.3 and 15 of this SER for further evaluation.

The SIS is automatically actuated to inject borated water into the reactor coolant system when a safety injection signal 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 primarily 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, and the boron injection tank) injects a concentrated boron solution into the RCS to help ensure plant shutdown in the event of a safety injection signal. 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 centration 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.

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.

The reactivity control systems, including the addition of concentrated boric acid solution by the SIS, and the charging pumps via the boron injection tank 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 with respect to accidents and transients, refer to Sections 6.3 and 15.3 of this SER). All accidents are calculated 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.

Compliance with the requirements of General Design Criterion 28 is discussed in Sections 4.3 and 15.0 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 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 control rod drive system meets the acceptance criteria of SRP Section 4.6.

5.2.5 Reactor Coolant Pressure Boundary Leakage Detection

The reactor coolant pressure boundary leakage detection systems were reviewed in accordance with Section 5.2.5 of NUREG-0800 (SRP). 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 steam 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 Detect~~opm~~ion Systems."

In the containment building, identified leakage from valve stems, pump seals, reactor vessel flange and from pressurizer relief valves, is kept within a closed system by being piped to the reactor coolant drain tank or pressurizer relief tank. Flow or temperature devices are provided in the leak-off lines to indicate the source of leakage. The reactor coolant drain 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 rec~~overy~~ycle system through flow monitoring devices.

All RCPB leakage in the containment structure which is not collected in the reactor coolant drain tank or in the pressurizer relief tank is collected in the containment normal sump or reactor cavity sump. Unidentified leakage is monitored by sump level and sump pump running monitoring systems. Indication and means to determine leak rate in gpm is provided in the control room. Thus, the guidelines of Regulatory Guide (RG) 1.45, Position C.2 regarding collection of unidentified leakage and flow monitoring ~~is~~ are met.

Unidentified leakage is also detected by containment airborne particulate radioactivity and gaseous radioactivity monitors which are qualified to remain functional when subjected to the safe shutdown earthquake. These monitors respond to the increase in airborne radioactivity resulting from leakage. The time to detect reactor coolant leakage by airborne particulate and gaseous radioactivity-monitors depends upon reactor coolant activity level, location of leakage, leak rate, and background concentration due to previous leakage. The applicant stated that with 0.01-percent failed fuel and with background airborne activity of 10^{-3} percent/day or background gaseous activity equivalent to 1.0 percent/day, a one gpm leak can be detected in approximately 1 hour with the particulate and gaseous monitoring systems. Indicators and alarms are provided in the control room to detect high airborne or gaseous radioactivity in the containment. As a backup, unidentified leakage is also detected by pressure, temperature and humidity monitors. Indications and/or alarms are provided in the control room. Thus, the guidelines of RG 1.45, Positions C.3, C.5, and C.6 regarding methods of unidentified leak detection, sensitivity and capability to perform its function ~~of~~ following an earthquake are satisfied. Also since the particulate and gaseous radioactivity monitors are qualified for the safe shutdown earthquake the guidelines of Regulatory Guide 1.29 "Seismic Design Classification," are satisfied.

For intersystem monitoring, radiation monitors are used to detect reactor coolant leakage into cooling water systems which supply the RHR heat exchangers, letdown heat exchangers, 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. Acuumulator leakage is detected by level and pressure indications and alarms provided for each accumulator. Thus, the guidelines of RG 1.45, Position C.4 regarding intersystem leakage, are satisfied.

The applicant has provided indication and alarm for the leak detection system in the control room as well as provisions for testing and calibration during plant operation. Thus the guidelines of RG 1.45, Position C.7 and C.8 regarding instruments and alarms and provisions for testing and calibration are satisfied.

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 the reactor coolant pressure boundary leakage detection systems are diverse and provide reasonable assurance that primary system leakage (both identified and unidentified) will be detected. We further conclude that the system meets the requirements of General Design Criteria 2 and 30 with respect to protection against earthquakes and provisions for reactor coolant pressure boundary leak detection and identification, and meets the guidelines of Regulatory Guides 1.29 and 1.45, Positions C.1 through C.8 with respect to seismic classification and leakage detection system design. We, therefore, conclude the reactor coolant pressure boundary leakage detection systems are acceptable and meet 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 NUREG-0800 (SRP). 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, and the drain to the liquid waste processing system. The system is non-safety-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 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 condense and cool a discharge of steam equivalent to 110% of the full-power pressurizer steam volume through the primary relief and safety valves without exceeding a pressure/temperature condition of 50 psig/200°F in the tank. Other discharges to the pressurizer relief tank include a reactor vessel head vent and the relief valves 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 sprayer and bottom drain on the pressurizer relief tank are used to cool the water in the tank through a feed and bleed process. 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 reactor coolant drain tank where it can be pumped to the gaseous radwaste system or the boron recycle system. 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 in the control room to indicate and alarm high pressure, high temperature and high and low water levels.

The tank is separated from safety-related equipment so that its failure will not compromise the capability to safely shut down the plant, and further, possible rupture disc fragments do not present a missile hazard when the discs 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 and C.3, 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 meets the guidelines of Regulatory Guide 1.29, Positions C.2 and C.3, concerning its seismic classification. We therefore conclude the pressurizer relief discharge system is acceptable and meets the acceptance criteria of SRP Section 5.4.11.

9.1 Fuel Storage and Handling

9.1.1 New Fuel Storage

The new fuel storage facility was reviewed in accordance with Section 9.1.1 of NUREG-0800 (SRP). 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, forms the basis for our evaluation of the new fuel storage facility with respect to the applicable regulations of 10 CFR 50.

The acceptance criteria for the new fuel storage facility include meeting the guidelines of ANS 57.1, "Design Requirements of Light-Water Reactor Fuel Handling System," and ANS 57.3, "Design Requirements for New LWR Storage Facilities." The guidelines contained in the "Review Procedures" were used in lieu of the specific guidelines of ANS 57.1 and ANS 57.3.

A single new fuel storage facility located in the fuel handling building is used to serve both units. The new fuel storage facility provides dry storage for 162 fuel assemblies (approximately 2/3 of a core load plus about 30 spares) and includes the new fuel storage racks and the concrete storage vault that contains the storage racks.

The fuel handling building which houses the facility is Seismic Category I as are the storage racks and vault. This building is also designed against flooding and tornado missiles (refer to Sections 3.4.1 and 3.5.2 of the SER). Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidance of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1, are satisfied.

The new fuel storage vault is not located in the vicinity of any high energy lines or rotating machinery. Physical protection by means of separation and a vault cover is provided for new fuel from internally generated missiles (including gravitational) and the effects of pipe breaks, and therefore the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," are met as described in Sections 3.5.1.1 and 3.6.1 of this SER.

The new fuel storage facility is shared between units. This sharing does not increase the potential for or ~~increase~~ the consequences of a fuel handling accident. The shared new fuel storage facility also has no effect on the ability to perform a safe shutdown of both units in the event of an accident in one unit. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are satisfied since it has been demonstrated that this sharing will not impair the new fuel storage facility's safety functions, i.e., prevent criticality and minimize radioactive releases. X

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

The new fuel storage racks are designed to store the fuel assemblies in an array with a minimum center-to-center spacing of 21 inches which is sufficient to maintain a K_{eff} of less than 0.95 with the fuel asemblies of the highest anticipated enrichment (3.5 percent) and flooded with unborated water. The racks themselves are designed to preclude the inadvertent placement of a fuel assembly in other than the prescribed spacing. The 21-inch spacing is also sufficient to assure that a K_{eff} of 0.98 or less can be maintained in the storage vault when optimum moderation conditions are present. Therefore, we conclude that the requirements of General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling," are satisfied.

Based on our review, we conclude that the new fuel storage facility is in conformance with the requirements of General Design Criteria 2, 5, 61, and 62 as they relate to protection against natural phenomena, shared systems, radiation protection, and prevention of criticality and the guidelines of

Regulatory Guide 1.29, relating to seismic classification and is, therefore, acceptable. 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 NUREG-0800 (SRP). 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 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" were used in lieu of ANS 57.2. However, the applicant has stated in the FSAR that the facility is designed to the guidelines of ANS 57.2. Additionally, the acceptance criteria includes Regulatory Guide 1.115, "Protection Against Low Trajectory Turbine Missiles." Our review of internally generated missiles does not include turbine missiles. Turbine missiles are evaluated separately in Section 3.5.1.3. of this SER.

A separate spent fuel storage facility for each unit is located in the fuel handling building that serves both units. Each facility provides underwater storage for 936 fuel assemblies or approximately 4 2/3 full core loads and include the spent fuel storage racks and the lined spent fuel storage pool that contains the storage racks. X

The structure housing the facilities (the fuel handling building) is designed to seismic Category I criteria as are the stainless steel storage racks, storage pools (including the gates between the storage pools and cask-loading pool), pool liners, fuel transfer canal, and cask loading area. The fuel handling building is also designed against flooding and tornado missiles (refer to Sections 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 Guides 1.13, "Spent Fuel Storage Facility Design Basis," Position C.3, 1.29, "Seismic Design Classification," Positions C.1 and C.2, and 1.117, "Tornado Design Classification," Positions C.1 through C.3, are satisfied.

The fuel pool is not located in the vicinity of any high energy lines or rotating machinery. Therefore, protection of spent fuel from internally generated missiles and the effects of pipe breaks is provided by physical separation (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 Regulatory Guide 1.13, Position C.3, concerning missile protection for spent fuel are satisified.

A separate spent fuel storage facility is provided for each unit. There is no sharing between the units except for the common cask loading and washdown area. Therefore, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are satisfied since the common cask area is only used with one facility at a time.

The spacing and the design of the racks is such that the effective multiplication factor (K_{eff}) will not exceed 0.95 under all conditions including fuel handling accidents. The rack arrays have a center-to-center spacing of 13.0 inches. The storage cells do not use a neutron absorber to ~~maintain~~ keep K_{eff} from exceeding 0.95. The racks are designed ~~by~~ with close spacing ~~to~~ which precludes the inadvertent placement of a fuel assembly between storage cells. Inadvertent placement of a fuel assembly between the racks and pool walls or on top of the racks will not result in K_{eff} exceeding 0.95. The racks can withstand the impact of a dropped fuel assembly without unacceptable damage to the stored fuel and can withstand the maximum uplift forces exerted by the fuel handling machine. Thus, 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 concerning the protection of fuel from mechanical damage and prevention of criticality are satisfied.

The design of the storage pool includes pool water level radiation and temperature monitoring systems with local indication and alarm in the control room. These features satisfy the requirements of General Design Criterion 63, "Monitoring Fuel and Waste Storage."

Based upon our review, we conclude that the spent fuel storage facility is in conformance with the requirements of General Design Criteria 2, 4, 5, 61, 62, and 63 as they relate to protection against natural phenomena, missiles, pipe break effects, shared systems, fuel storage and handling, prevention of criticality and monitoring provisions, and the guidelines of Regulatory Guides 1.13, 1.29, and 1.117 concerning the facility's design, seismic classification, and protection against tornado missiles. We, therefore, conclude that the spent fuel storage facility design meets the acceptance criteria of SRP Section 9.1.2 and is acceptable.

9.1.3 Spent Fuel Pool Cooling and Cleanup System

The spent fuel pool cooling and cleanup system was reviewed in accordance with Section 9.1.3 of NUREG-0800 (SRP). 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 pool cooling and cleanup system with respect to the applicable regulations of 10 CFR 50.

The acceptance criteria for the spent fuel pool cooling and cleanup system includes meeting the guidelines of Regulatory Guide 1.52, "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 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable." Compliance with the guidelines of Regulatory Guides 1.52 and 8.8 are discussed separately in Sections 6.5.9.4, and 12.1 of this SER.

The spent fuel pool cooling and cleanup system (a separate system is provided for each unit) is designed to remove the decay heat generated by the spent fuel assemblies and to maintain clarity and purity of the spent fuel pool water. The spent fuel pool cooling system is designed to remove the decay heat generated by the spent fuel assemblies that are stored following a refueling of the unit and the accumulated fuel assemblies from previous cyclic refuelings. The system includes all components and piping from inlet to exit from the storage pool, piping used for fuel pool makeup, and the cleanup filters and demineralizer to the point of discharge to the radwaste system. Each system consists of two fuel pool cooling trains each with a spent fuel pool pump and heat exchanger. A separate single train cleanup system consisting of a fuel pool skimmer pump, filters, strainers, and demineralizer are provided for maintaining the pool water clarity. A separate reactor cavity filtration unit consisting of a pump and filters are also provided for maintaining the refueling canal water clarity.

The essential portions of the system are housed in the seismic Category I, flood and tornado protected fuel handling building (refer to Sections 3.4.1 and 3.5.2 of this SER). The system itself, with the exception of the cleanup portion, is designed to Quality Group C and seismic Category I requirements. Failure of the nonseismic Category I, Quality Group D cleanup portion will not affect operation of the cooling train as the two are completely separate and adequate isolation capability has been provided. 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 Basis," and 1.29, "Seismic Design Classification," Positions C.1 and C.2, with respect to seismic classification of the spent fuel pool cooling system.

The various components of the system are located in separate missile shielded cubicles within the tornado missile protected fuel handling building and are separated from other moderate and high energy piping systems (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 Regulatory Guide 1.13, Position C.2, are satisfied.

As stated previously, each unit has its own spent fuel pool cooling and cleanup system and there is no sharing between units. Therefore, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are not applicable.

With the loss of either a pump or heat exchanger, the fuel pool cooling system maintains the pool water temperature at or below 131°F with a heat load based on decay heat generation for the maximum design storage case of one-third of a core 150 hours after shutdown, plus one-third of a core per year from the annual refueling of the previous 10 years (full pool minus space for one full core offload.) This maximum "normal" heat load temperature meets the SRP Section 9.1.3 acceptance criterion of 140°F.

The maximum "abnormal" heat load is based on a loading of 1/3 core for ten years and an additional full core loaded into the pool 10 days after the most recent refueling of 40 percent fuel was added. With two trains operating for this "abnormal" heat load case, the pool water temperature will remain below 150°F and for single train operation the pool water temperature will not exceed 170°F. Both these temperatures meet the SRP Section 9.1.3 acceptance criterion of no boiling for the "abnormal" heat load case.

The applicant used the standard Westinghouse methods for decay heat load calculations. The applicant also performed an analysis to compare the Westinghouse methods with the methods of Branch Technical Position ASB 9-2. The results of the analysis showed that the Westinghouse method resulted in a calculated difference of 6 percent which would result in a calculated pool water temperature of one to two degrees (°F) lower than if ASB 9-2 methods were used. In order to verify that the methods used by the applicant were acceptable, we performed an independent heat load calculation for the maximum "abnormal" heat load using the methods set forth in ASB 9-2. Our calculations resulted in a maximum "abnormal" heat rate of 49.3×10^6 BTU/HR. The applicant's methods resulted in a decay heat rate of 49.1×10^6 BTU/HR. Based on this favorable comparison, we conclude that the applicant's analysis is acceptable. Since the applicant's methods of determining heat loads are acceptable and the maximum calculated pool temperatures meet the acceptance criteria of SRP Section 9.1.3 we conclude that the requirements of General Design Criterion 44 "Cooling Water" are satisfied.

All connections to the spent fuel pool are either near the normal water level or are provided with antisyphon holes to preclude possible syphon draining of the pool water. The safety related primary component cooling water system provides cooling water to the fuel pool heat exchanger and transfers its heat to the ultimate heat sink (refer to Sections 9.2.2 and 9.2.5 of this SER). The spent fuel pool pumps can be powered from the emergency (Class 1E) power sources.

The design of the spent fuel pool cooling system and its accessible location is such that periodic testing and inservice inspection of the system can be accomplished. The active components of the spent fuel pool cooling system are either in continuous or intermittent operation during all plant operating conditions. Thus, the requirements of General Design Criteria 45, "Inspection of Cooling Water System," and 46, "Testing of Cooling Water System," are satisfied.

Normal makeup to the spent fuel pool to replace normal operational losses (evaporation, seal leakage) can be provided from the refueling water storage tank (RWST), the reactor water makeup tank (RWMT), the demineralized water storage tank (DWST), or the recycle holdup tanks. The RMWT serves as a seismic Category I makeup water source for the pool; makeup water can be pumped via the reactor makeup water pumps or gravity fed to the spent fuel pool via seismic Category I piping and valves. Water from the seismic Category I RWST may be pumped through the nonseismic purification system or gravity fed through seismic Category I piping and valves. Thus, the requirements of General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control" and the guidelines of Regulatory Guide 1.13, Position C.6 concerning fuel pool design are met.

The system incorporates control room alarmed pool water level, temperature and building radiation level monitoring systems. The seam welds in the pool, transfer canal and cask pit liners are also equipped with a continuous drain systems which monitor leakage through the liners. Thus, the requirements of General Design Criterion 63, "Monitoring Fuel and Water Storage," are satisfied. Refer to Section 12.3 of this SER for further discussion of area radiation monitoring systems.

Based on our review, 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 as they relate to protection against natural phenomena, missiles, shared systems, cooling capability, inservice inspection, functional testing, radiation protection and monitoring systems, and also in conformance with the guidelines of Regulatory Guides 1.13, and 1.29 relating to the system's design and seismic classification. We, therefore, conclude that the spent fuel pool cooling and purification system is acceptable and meets the acceptance criteria of SRP Section 9.1.3.

9.1.4 Light Load Handling System (Related to Refueling)

The light load handling systems were reviewed in accordance with Section 9.1.4 of NUREG-0800 (SRP). 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 light load handling system with respect to the applicable regulations of 10 CFR 50.

The acceptance criteria for the light load handling systems include meeting the guidelines of ANS 57.1, "Design Requirements for LWR Fuel Handling Systems." Although the applicant stated that the design meets the guidelines of ANS 57.1 the guidelines contained in the "Review Procedures" were used for our review in lieu of ANS 57.1.

The light load handling system in conjunction with the fuel storage area provides the means of transporting, handling, and storing new and spent fuel. The system consists of the equipment necessary to facilitate the periodic refueling of the reactor and includes the refueling machine, fuel handling machine, new fuel elevator, the fuel transfer system, and associated handling tools and devices. The handling of fuel during refueling is controlled by a series of interlocks to assure that fuel handling procedures are maintained. The design assures that no failure will result in release of radioactivity in excess of that assumed in the design basis fuel handling accident.

The refueling machine is a rectilinear bridge and trolley system with a vertical mast extending down into the refueling water. The machine is used to handle new and spent fuel assemblies within the reactor vessel and refueling cavity inside the containment. Electrical interlocks and limit switches on the bridge and trolley drives are provided to prevent damage to the fuel assemblies. Redundant limit switches on the mast which are designed to prevent a fuel assembly from being raised above a safe shielding water depth.

The fuel handling machine is a wheel mounted walk way with a trolley-mounted electric hoist. It is used exclusively for handling fuel assemblies within the spent fuel storage area including loading fuel into the spent fuel racks and the spent fuel cask. The hoist trolley is hand operated by a chain drive.

The new fuel elevator is used to lower new fuel assemblies (one at time) to the bottom of the fuel storage area where they can be transported by the spent fuel pool bridge crane to the storage racks. The elevator winch has a load sensor which is designed ~~to prevent a fuel assembly from being raised~~ to only allow lowering of a fuel assembly in the elevator.

The fuel transfer system includes an underwater electric-motor-driven transfer car that runs on tracks extending from the refueling canal through the transfer tube and into the fuel storage area. Fuel assemblies are placed on the car within the refueling canal by the refueling machine and removed within the spent fuel pool by the fuel handling machine after passing horizontally through the transfer tube.

The entire system is housed within the fuel handling building and reactor containment which are seismic Category I, flood and tornado protected structures (refer to Sections 3.4.1 and 3.5.2 of this SER). Although fuel handling system components are not required to function following 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 which results in unacceptable consequences such as fuel damage or damage to safety related equipment. The fuel handling machine which travels over the spent fuel storage racks as described above is designed to seismic Category I requirements. The design thus 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 Basis," Positions C.1 and C.6, and 1.29, "Seismic Design Classification," Positions C.1 and C.2.

Most of the fuel handling equipment (light load) is not shared between units. However the fuel handling machine and new fuel elevator are shared between units since they both can service either spent fuel pool. However, since they are used to service only one unit at a time and since a failure of either will only affect one spent fuel assembly or pool at a time, the requirements of General Design Criterion 5, "Sharing of Structures, Systems, and Components," are satisfied.

The applicant has verified that light loads (those that weigh less than a fuel assembly plus handling fixture) when dropped over the fuel pool or reactor vessel from their maximum normal elevation will not result in greater fuel damage than that assumed for a dropped fuel assembly in the design basis fuel handling accident. Hence, the resulting radiological releases would be less than those assumed in the 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, Position C.3, 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, 5, 61 and 62 as they relate to protection against natural phenomena, shared systems, safe fuel handling including prevention of criticality, and the guidelines of Regulatory Guides 1.13, Positions C.1, C.3, and C.6, and 1.29, Positions C.1 and C.2, with respect to overhead crane interlocks, prevention of unacceptable releases in fuel handling accidents, and maintaining plant safety in a seismic event, and is therefore acceptable. The light load handling system meets the ~~acceptable~~ acceptance criteria of SRP Section 9.1.4. X

9.1.5 Overhead Heavy Load Handling System

The overhead heavy load handling system is currently being reviewed by our consultants, EG&G, Idaho Inc. EG&G is evaluating the system against the guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." We will provide our safety evaluation when the EG&G review is complete.

9.2.1 Nuclear Service Water Cooling System (Station Service Water System)

The nuclear service cooling water (NSCW) system was reviewed in accordance with Section 9.2.1 of NUREG-0800 (SRP). 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 NSCW with respect to the applicable regulations of 10 CFR Part 50.

The NSCW system performs both safety and nonsafety functions supplying cooling water to the plant from the ultimate heat sink. The ultimate heat sink is discussed in detail in Sections 2.4 and 9.2.5 of this SER.

A separate independent NSCW system is provided for each Vogtle unit. Since each units' NSCW system is identical to each other, this evaluation describes one unit's system but applies to both units.

The NSCW system for each unit, consists of two 100 percent capacity trains. Each train has three 50-percent capacity pumps and a 100 percent capacity cooling tower. A safety-related transfer pump is also provided for each train to transfer water between cooling tower basins if the need should arise. Each train of the NSCW system supplies cooling water to containment and air coolers, containment auxiliary air cooling coil, control building esential chiller, various engineered safety features (ESF) pumps motor and lube oil coolers, diesel generator coolers, piping penetration cooler, reactor cavity cooling coil, component cooling water (CCW) heat exchanger and the auxiliary component cooling water (ACCW) heat exchanger. The ESF pump motor and lube oil coolers served by the NSCW system are; RHR pump motor cooler, containment spray pump motor cooler, CCW pump motor coolers, safety injection pump motor and lube oil coolers, and the centrifugal charging pump motor and lube oil coolers.

During normal power operations, one NSCW train is operating with two pumps in service. The third pump is an installed spare which automatically starts on a low pressure signal if one of the operating pumps stops or fails to start. during other plant operating modes including post-accident conditions, both NSCW trains may be operating although one train is sufficient to bring the plant to a safe cold shutdown. In the event of a loss of offsite power or a safety injection signal, both trains are automatically initiated with two pumps in each train running after being sequenced on to their respective emergency busses. ~~if diesel operation is required.~~

The NSCW system supplies cooling water at a higher pressure than the fluid in the safety-related component being cooled. Therefore, if leakage occurs it will be into the cooled system. However, radiation monitors are installed in the return line to each cooling tower to further protect against radioactivity releases. Differential flow sensors and alarms are provided to detect leakage from the system. The various flows which are monitored and alarmed are: total NSCW pump flow vs. return flow to the NSCW cooling tower spray header, inlet vs. outlet flow across the CCW and ACCW heat exchangers, flow to and from the diesel generators, inlet vs. outlet flow across pairs of containment air coolers, and inlet vs. outlet flows across the reactor cavity and containment auxiliary air-cooling coils.

All safety-related portions of the NSCW system are housed in seismic Category I, flood and tornado protected structures. Underground piping is run in seismic Category I tunnels which are also protected against natural phenomena. The system itself is designed to seismic Category I, Quality Group C requirements. Thus, the requirement of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena" and the guidelines of Regulatory Guide 1.29 "Seismic Design Classification," are satisfied.

Since each unit has its own separate NSCW system and there is no sharing between units, the requirements of General Design Criterion 5 "Sharing of Structures, Systems and Components," ~~are satisfied~~ do not apply.

The NSCW system is designed to meet the single failure criterion. Power is supplied to the pumps in each train from a separate emergency bus backed by a diesel generator such that the failure ~~to start~~ of one diesel generator only affects one NSCW train. The NSCW transfer pump in each cooling tower basin is powered by the emergency diesel generator bus associated with the cooling water train associated with the basin to which the water is transferred. Each cooling water train can supply the minimum cooling water requirements during a design basis accident, including a LOCA, with or without offsite power, and during normal cold shutdown with or without offsite power. Thus, the requirements of General Design Criterion 44, "Cooling Water," are satisfied.

The NSCW system has also been designed to minimize the effects of water hammer. Interties (2 inch) between the two supply headers have been provided to act as a "keep full" system for the idle train. In order to further preclude water hammer in an idle train or on pump restart following a loss of offsite power, the NSCW system includes; 1) interlocks and pressure switches to close both tower valves (spray header and cold weather bypass valves) whenever the NSCW pumps in that train are not operating and to allow normal valve operation when the pumps are in service, 2) motor operators on the NSCW pump discharge valves, with interlocks to close if the respective pump is not running and to prevent pump start unless the valve is closed. These valves start to open when the respective pumps start, thereby limiting the rate of system repressurization, 3) check valves in the NSCW supply line to all components located above grade (prevent draining back to basin), 4) the "keep full" system described above, and 5) interlocks to close the NSCW tower blowdown valves unless at least two NSCW pumps in the respective train are operating.

The NSCW system incorporates provisions for accessibility to permit periodic inservice inspections as required and is capable of being functionally tested and inspected during normal plant operation. Normally two pumps (one train) in each unit will be operating. Thus, the requirements of General Design

Criteria 45, "Inspection of Cooling Water Systems," and 46, "Testing of Cooling Water System," are met.

Based on the above, we conclude that the nuclear service cooling water system meets the requirements of General Design Criteria 2, 5, 44, 45, and 46 with respect to natural phenomena, shared systems, decay heat removal capability, inservice inspection, and functional testing, and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2, with regard to seismic classification and is, therefore, acceptable. The nuclear service cooling water system meets the acceptance criteria of SRP Section 9.2.1.

9.2.2 Reactor Auxiliary Cooling Water Systems

The cooling water systems for reactor auxiliaries were reviewed in accordance with Section 9.2.2 of NUREG-8000 (SRP). 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 reactor auxiliary cooling water systems consist of the component cooling water (CCW), auxiliary component cooling water (ACCW), engineered safety features (ESF) chilled water, and the normal chilled water systems. These systems are used to provide cooling water for heat removal from reactor plant components. The CCW, ESF chilled water system and portions of ACCW system are safety-related.

9.2.2.1 Component Cooling Water System (FSAR Section 9.2.2)

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

The CCW system for each unit consists of two trains, each having three half capacity motor driven cooling water pumps, one full capacity heat exchanger, a surge tank, a chemical addition tank and associated piping, valves, and instrumentation. Each train of the system is designed to bring the reactor to cold shutdown conditions in 29 hours. With two trains operating cold shutdown can be achieved in 17 hours.

Each train of the CCW system provides cooling water to one safety-related spent fuel pool cooling heat exchanger, one RHR heat exchanger and its associated RHR pump seal cooler. The RHR pump motor coolers are supplied by the NSCW system as described in Section 9.2.1 of this SER.

The entire CCW system is 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 (as applicable) requirements. Nonsafety-related portions of the system such as the chemical addition tank are normally isolated. Thus, the requirements of General Design Criterion ~~(GDC)~~ 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1 are satisfied.

Each unit has its own independent CCW system with no sharing between units. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are satisfied.

The system is designed to meet the single failure criterion with two redundant trains to serve those components (RHR system) essential for safe shutdown and removal of decay heat from spent fuel. During normal operation, two CCW pumps and one heat exchanger (one train) will be in operation for cooling the spent fuel pool. A spare pump in each train is provided to allow for pump maintenance. The CCW pumps in each train are powered by the emergency bus associated with the NSCW system that supplies cooling water to that train. The spare pump in each train is normally on automatic standby. During accident conditions, one train is sufficient to accommodate the heat removal load. Seismic Category I makeup to each surge tank is available from the reactor water makeup system. Normal makeup is provided by the demineralized water storage system.

During normal plant operation, one train of the CCW system, using two pumps, is in continuous operation. The operating train ~~and pumps~~ may be varied to assure equal operating times for the pumps. Availability of pumps not running will be assured by periodic tests and inspections per the plant technical specifications. During the first fuel cycle neither train will be in operation during normal power conditions since no fuel will be in the spent fuel pool. During this time period, availability of all pumps will be demonstrated by periodic testing in accordance with the specifications. The system components are located in accessible areas to permit periodic inservice inspections as required. Thus, 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, the staff concludes that the CCW system meets the requirements of General Design Criteria 2, 5, 44, 45, and 46 with respect to protection against natural phenomena, shared systems, 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. It is, therefore, acceptable. The CCW system meets the acceptance criteria of SRP 9.2.2.

9.2.2.2 Auxiliary Component Cooling Water System (FSAR Section 9.2.8)

The auxiliary component cooling water (ACCW) system is a closed loop cooling water system that transfers heat to the NSCW system from reactor auxiliaries, not required for safe shutdown but essential for normal power operation and for normal shutdowns and cooldowns. It provides an intermediate barrier between radioactive or potentially radioactive heat sources and the NSCW which is open to the atmosphere.

The ACCW system for each unit consists of two full capacity heat exchangers (in series), two full capacity pumps, one surge tank, and associated piping, valves and instrumentation. The ACCW heat exchangers are in series such that heat can be removed from the ACCW system by either NSCW train without having redundant ACCW trains. Since the system is not required for safe shutdown full redundancy is not required.

The ACCW system provides cooling water to the positive displacement charging pump and motor coolers, waste and recycle evaporator equipment, waste gas compressors, catalytic hydrogen recombiners, sample coolers, reactor coolant drain tank heat exchanger, seal water heat exchanger, reactor coolant pump (RCP) motor coolers, RCP thermal barriers, RCP bearing lube oil coolers, letdown heat exchanger, excess letdown heat exchanger and the ACCW pump and motor coolers.

Safety-related portions of the system which are designed to seismic Category I, Quality Group B or C requirements are the containment penetrations and the automatically isolable portion of the system that serves the RCP thermal barriers. In the event of a leak in the RCP thermal barrier, the ACCW return line from each pump is isolated automatically on high flow from the individual pump. Each pump return line has its own automatic motor operated isolation valve. Downstream of these valves in the common return header is a redundant motor operated isolation valve which closes on high pressure or high flow in the return header. The return header isolation valve is powered from a different emergency bus than the individual isolation valves. A check valve in the supply line to each pump's thermal barrier provides the isolation on the inlet to the thermal barrier. The rest of the system that is necessary for normal plant operations, including startup and normal shutdown, is designed to seismic Category I, Quality Group D requirements. Portions of the system that are not seismically designed are provided with adequate isolation from the seismic Category I portions of the system. Thus, the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2 are satisfied.

In response to our concern (SRP Section 9.2.2) regarding loss of cooling water flow to the RCPs as a result of a single failure in the common supply line which might result in the occurrence of a locked rotor condition, the applicant indicated that testing performed by Westinghouse has shown that the RCPs will incur no damage as a result of flow interruption of ten minutes. This ten minute test with no damage indicates that the pumps could potentially run longer with loss of cooling water without the need for operator action. Safety-grade instrumentation and alarm have been provided which alarm in the control room upon the detection of low ACCW flow to the RCP motor and pump lube oil bearing coolers. Safety-grade instrumentation has also been provided to detect a loss of ACCW flow to the RCP seals. Other safety-grade instrumentation provided to aid in the detection of loss of ACCW flow include ACCW header flow, surge tank level, pressure, and valve position indication. Since safety-grade instrumentation has been provided to detect loss of ACCW flow to the RCP seals and bearings, and adequate RCP testing has been performed, we conclude that adequate time exists for the operator to trip the RCPs before unacceptable damage occurs. Since the ACCW pumps are automatically loaded onto the emergency buses following a loss of offsite power, with no safety injection signal present, the design meets the recommendations of Item II.K.3.25 of NUREG-0737 "Clarification of TMI Task Action Plan Requirements." Thus, the requirements of General Design Criterion 44 are satisfied.

During normal operation all portions of the ACCW system are either in continuous or intermittent operation or are otherwise available for periodic testing. The system components are located in accessible areas to permit periodic inservice inspection, as required. Thus, the requirements of General Design Criteria 45 and 46 are satisfied.

Since the systems are not shared between units, the requirements of General Design Criterion 5, are not applicable.

Based on the above, we conclude that the auxiliary component cooling water system meets the requirements of General Design Criteria 2, 5, 44, 45, and 46 with respect to protection against natural phenomena, shared systems, heat removal capability, inservice inspection and functional testing, the recommendations of Item II.K.3.25 of NUREG-0737 with respect to RCP seals, 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 auxiliary component cooling water system meets the acceptance criteria of SRP Section 9.2.2.

9.2.2.3 Normal and Essential Chilled Water Systems (FSAR Section 9.2.9)

The essential chilled water system is a closed loop system that transfers heat from essential air cooling units in the auxiliary, fuel handling, and control buildings to the NSCW system via the condensers of the essential chilled water system chillers.

The essential chilled water (ECW) system for each unit consists of two independent trains, each having a full capacity condenser water pump, chiller, chilled water pump expansion tank and associated piping, valves and instrumentation. The ECW system provides chilled water to the cooling coils of the air cooling units of various ESF rooms. These include the battery rooms, switchgear rooms, control room, ESF pump rooms, penetration areas and the spent fuel pool heat exchanger and pump rooms. The air handling units for many of these areas or rooms have two sets of cooling coils one of which is supplied by the normal chilled water (NCW) system and the other is supplied by the ECW system. During normal operation chilled water is supplied by the normal chilled water system and during accident conditions chilled water is supplied by the ECW system.

The essential portions of the ECW system are located in seismic Category I, flood and tornado protected structures. The essential portions of the system itself are designed to seismic Category I, Quality Group C requirements. Seismic Category I makeup capability is available from the reactor makeup water system while normal makeup is provided from the demineralized water system. Thus, the requirement of General Design Criterion 2, and the guidelines of Regulatory Guide 1.29, Position C.1 and C.2 are satisfied.

Since each unit has its own ECW system the requirements of General Design Criterion 5, are not applicable.

During normal plant operation one train of the ECW system is operating with the other on standby. Each train is powered from the emergency bus associated with the equipment ~~and~~ it cools. A safety injection signal automatically starts both trains of the ECW system. Both trains of the ECW system also start following a loss of offsite power since the NCW system is not loaded onto the emergency buses. Since each train of the system can supply adequate chilled water to reach safe shutdown, the system meets the single failure criterion. Nonessential portions of the system (chemical addition) are normally isolated from the essential portions of the system by seismic Category I isolation valves. Thus, the requirements of General Design Criterion 44 are met.

During normal operation all portions of at least one train of the system are in continuous or intermittent operation, and the operating train can be ~~varied~~ alternated between the two trains for equalized running time. The system components are accessible to permit periodic inservice inspection as required. Thus, the requirements of General Design Criteria 45 and 46 are satisfied.

The normal chilled water (NCW) system supplies chilled water to essential and nonessential cooling units during normal plant operation. During other than normal plant operations such as an accident or loss of offsite power, the essential air cooling units are supplied chilled water from the ECW system. The normal chilled water system is designed such that a seismic event will not result in failures that could affect the ECW system or other seismic Category I systems in accordance with the guidelines of Regulatory Guide 1.29, Position C.2. Thus, the requirements of General Design Criterion 2, are satisfied.

Since the NCW system is not necessary for safe plant shutdown or to prevent the release of radioactivity the system is not safety related and it is not designed to seismic Category I requirements. Thus, the requirements of General Design Criteria 5, 44, 45 and 46 are not applicable.

Based on the above we conclude that the essential and normal chilled water systems meet 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. Also based on the above we conclude that the essential chilled water system meets the requirements of General Design Criteria 5, 44, 45 and 46 as they relate to sharing, cooling water system design, and periodic inspection and testing. We, therefore, conclude that the essential and normal chilled water systems meet the acceptance criteria of SRP Section 9.2.2 and are acceptable.

9.2.2.4 Turbine Building Closed Cooling and (Open) Cooling Water Systems (FSAR Sections 9.2.10 and 9.2.11)

The turbine plant closed cooling water (TPCCW) system is a nonsafety-related system that removes heat from various turbine building heat exchangers and transfers the heat to the circulating water system cooling tower via the nonessential turbine plant (open) cooling water (TPCW) system. X

Equipment cooled by the TPCCW system includes air compressors, condensate pumps, heater drain pumps, turbine plant sampling system and electrohydraulic control coolers. Equipment cooled by the TPCW system includes the TBCCW heat exchangers, feedwater pumps, turbine lube oil coolers, normal chilled water system chillers, chemical and volume control system chillers and turbine generator components.

Neither the TPCCW nor the TPCW system are required to be designed to seismic Category I requirements since they are not required for safe plant shutdown and their failure will not affect safe plant shutdown or other seismic Category I equipment. Thus the guidelines of Regulatory Guide 1.29, Position C.2, and the requirements of General Design Criterion 2 are satisfied.

Since these systems are not required for safe plant shutdown and are not safety related, the requirements of General Design Criteria 5, 44, 45 and 46 are not applicable.

Based on the above, we conclude that the turbine plant closed cooling water and (open) cooling water systems meet the requirements of General Design Criterion 2 as related to requiring protection from natural phenomena and the guidelines of Regulatory Guide 1.29, Position C.2 as related to seismic design classification. We, therefore, conclude that the turbine building closed cooling and cooling water systems meet the acceptance criteria of SRP Section 9.2.2 and are acceptable.

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 Part 50.

The nonsafety-related demineralized water makeup system (Quality Group D, nonseismic Category I) provides demineralized water to the reactor makeup water storage tanks, the condensate storage tanks, the component cooling water system, the auxiliary component cooling water system, the turbine plant closed cooling water system, the auxiliary steam system, the liquid radwaste system and to other service points such as for use in laboratories for washdown of equipment. Water is supplied to the demineralized water makeup system from a well water storage tank by the demineralizer booster pumps.

The demineralized water makeup system includes two trains of filtration and demineralization, a 250,000 gallon demineralized water storage tank, three 50 percent capacity demineralized water transfer pumps, three 50 percent capacity demineralizer booster pumps and one 100 percent capacity demineralizer backwash pump.

The system has no safety related functions. Adequate isolation is provided at all demineralized water makeup system connections to safety related systems. Adequate protection from flooding for safety related equipment resulting from failure of the system is provided as discussed in Sections 3.4.1, 3.6.1 and 9.3.3 of this SER. The demineralized water makeup system is common to both plant units. The system is capable of fulfilling the normal operating requirements of the facility for acceptable makeup water with the necessary component redundancy. Check valves prevent contamination of the demineralizer water makeup system at each point of discharge from the system by backflow from the systems which it supplies. Instrumentation, including alarms, has been provided to prevent delivery of off-specification water to all systems. Failure of the system does not affect the capability to safely shut down either unit as described above; thus, the requirements of General Design Criteria 2, "Design Bases for Protection Against Natural Phenomena," and 5, "Sharing of Structures, Systems and Components," and the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Position C.2, are met.

Based on our review, we conclude that the demineralized water makeup system meets the requirements of General Design Criteria 2 and 5 with respect to the need for protection against natural phenomena and shared systems as its failure does not affect safety system functions, and meets the guidance of Regulatory Guide 1.29, Positions C.1 and C.2, concerning its seismic classification, and is, therefore, acceptable. The demineralized water makeup system meets the acceptance criteria of SRP Section 9.2.3.

9.2.4 Potable and Sanitary Water Systems

The potable and sanitary water 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 concluding that the potable and sanitary water systems satisfied the applicable regulations of 10 CFR Part 50.

The nonsafety-related (nonseismic Category I) potable and sanitary water system provides water for domestic use and human consumption. The water is supplied from two onsite station wells. The applicant provided drawings which illustrate the distribution of the potable water system with respect to the sanitary drainage system which shows that there is no connection with the radioactive drainage system or that no radioactive fluid could inadvertently flow into a nonradioactive floor drain. All branches of the potable water system supplying fixtures in potentially radiological areas are provided with backflow prevention devices. Thus, we conclude that the requirements of General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," are satisfied.

Protection from flooding for safety-related equipment resulting from failure of the system is discussed in Sections 3.4.1, 3.6.1, and 9.3.3 of this SER. Failure of this system does not affect plant safety as described above.

Based on our review, we conclude that the potable and sanitary water system meets the requirements of General Design Criterion 60 with respect to prevention of release of potentially radioactive water, and is, therefore, acceptable. The potable and sanitary water system meets 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 except as noted below, formed the basis for our evaluation of the ultimate heat sink with respect to the applicable regulations of 10 CFR Part 50.

The acceptance criteria for the ultimate heat sink includes Regulatory Guide 1.72, "Spray Pond Piping Made From Fiberglass-Reinforced Thermosetting Resin." The ultimate heat sink for Vogtle consists of cooling towers, therefore, this acceptance criterion is not applicable.

Each unit of the Vogtle plant has its own ultimate heat sink (UHS) consisting of two full capacity mechanical draft cooling towers. One tower is associated with each train of the nuclear service cooling water (NSCW) system. Refer to Section 9.2.1 of this SER for a discussion of the NSCW system. Each tower is subdivided into four individual fan cells. The fans are powered from the same emergency bus that powers the NSCW pumps associated with their respective trains (Train A pumps and Train A fans are powered from the Train A diesel generator). Only three of the four fans in one cooling tower are required to operate for safe plant shutdown without exceeding design temperature limits.

The UHS, including the pump house are designed to seismic Category I requirements, and are flood and tornado protected. Flood protection and tornado missile protection are evaluated in Sections 3.4.1 and 3.5.2 of this SER, respectively. 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 1.27, "Ultimate Heat Sink for Nuclear Power Plants," Positions C.2 and C.3, and 1.29 "Seismic Design Classification," Position C.1, are satisfied. [As discussed in Section 3.5.2 of this SER, tornado missile protection for the cooling tower fans requires further review and evaluation.] X

During normal plant operation one train of the NSCW system is in continuous operation. To guard against icing or freezing, at low temperatures in the return line to the cooling tower, two valves function to bypass the cooling tower spray headers and return the water directly to the cooling tower basin. A drain hole is provided in each of the four 12-in supply headers to the spray nozzles to promote self-draining. Small stagnant lines and idle piping are protected from freezing by electric heat tracing. Freezing of the water in the idle basin can be prevented by operating both NSCW trains or by operating both basin transfer pumps thereby mixing the two volumes of water. Also the basin water level is below ground with the depth of water being approximately 80 feet which will tend to minimize the possibility of freezing. The NSCW pumps' shaft and impellers are located within a concrete casing surrounded by soil and the pumps and motors are further protected by the concrete pumphouse. Thus ~~the requirements of General Design Criterion 4 and~~ the guidelines of Regulatory Guide 1.27, Position C.2 are satisfied regarding the potential for UHS freezing. X

There is no sharing of the UHS between units, since each unit has its own redundant UHS. Thus, the requirements of General Design Criterion 5 "Sharing of Structures, Systems and Components," are satisfied.

In accordance with Position C.3 of Regulatory Guide 1.27, the UHS for each unit consists of two water sources. The methods used by the applicant for the calculation of residual decay heat input to the UHS are consistent with our Branch Technical Position ASB 9-2 "Residual Decay Energy for Light Water Reactors for Long-Term Cooling." As evaluated in Section 9.1.3 of this SER we performed our own independent decay heat analysis using ASB 9-2 and compared the results to those obtained by the applicant and concluded the applicant's methods for calculating decay heat are acceptable. Based on the applicant's analyses the combined basin volume for each unit has a 26.7 day supply of water following a LOCA assuming two train operation for one day and one train operation thereafter. Position C.1 of Regulatory Guide 1.27 and SRP Section 9.2.5 specify that a minimum of 30 days water supply without makeup should be provided unless it can be demonstrated that replenishment or use of an alternate water supply can be effected, taking into account the availability of replenishment equipment and limitations that may be imposed on "freedom of movement" following an accident or occurrence of severe natural phenomena. The reduction below 30 days has occurred since the CP stage because of increased diesel generator rating (2.4 days) high density spent fuel storage (2.1 days) and new "worst 30-day" meteorological data (1.7 days). The analysis at the CP stage resulted in greater than 30 days supply. Two makeup sources of water may be used for the UHS cooling tower basins, the makeup water wells located on site and the Savannah River via the river makeup water pumps. Both sources are nonsafety related and are used for normal makeup to the NSCW cooling towers and the natural draft cooling towers. Both sources are also considered as the long term (>30 days) makeup to the UHS in accordance with Regulatory Guide 1.27, Position C.1, which recommends that procedures be available for assuring a continued capability after 30 days (Refer to SER Section 2.4.11). Taking into consideration the amount of conservatism used in the heat transfer analysis, including meteorological assumptions, and based on having procedures available for a continued supply of water after 30 days that could be instituted prior to the end of 30 days, we conclude that having a total inventory 3.3 days less than 30 days is an acceptable deviation from the recommendations of SRP Section 9.2.5 and Regulatory Guide 1.29. Thus, the requirements of General Design Criterion 44 "Cooling Water," are met.

Components of the UHS which are not normally operating will be tested in accordance with plant technical specifications. The UHS components are accessible to permit periodic inservice inspection as required. Thus, the requirements of General Design Criteria 45 "Inspection of Cooling Water System," and 46, "Testing of Cooling Water System," are met.

Based on the above, we conclude that the UHS meets the requirements of General Design Criteria 2, 5, 44, 45, and 46 with respect to protection against natural phenomena, shared systems, decay heat removal capability, inservice inspection, functional testing, guidelines of Regulatory Guides 1.29 Position C.1 and 1.27 Positions C.1, C.2 and C.3 and BTP ASB 9-2 with respect to design capability, protection from freezing, seismic classification, and capability to remove sufficient decay heat to maintain plant safety and is, therefore, acceptable. The ultimate heat sink meets the applicable acceptance criteria of SRP Section 9.2.5 with the approved deviation that a 26.7 day water supply is available in lieu of a 30 day supply following a LOCA and assuming the worst 30 day meteorological conditions. [The adequacy of tornado missile protection for the cooling tower fans requires further review as discussed in Section 3.5.2 of this SER.]

9.2.6 Condensate Storage Facilities

The condensate storage facility 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 accepance criteria formed the basis for our evaluation of the condensate storage facility with respect to the applicable regulations of 10 CFR Part 50.

The condensate storage facility serves as a safety-related source of water for the auxiliary feedwater system and provides makeup and surge capacity for the nonsafety related steam and power conversion system. Each plant unit has an independent condensate storage facility which consists of two condensate storage tanks, a transfer pump, a degasifier system, and associated piping valves and instrumentation. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are satisfied.

The condensate storage tanks, piping and valves to the auxiliary feedwater (AFW) system are designed to seismic Category I, Quality Group C requirements. The tanks are located in the yard area next to the AFW pumphouse, and are protected against tornado missiles by the concrete construction (stainless steel liner) and is inherently protected against flooding. Each tank has an operating capacity of 480,000 gallons and is designed to contain a sufficient reserve of water for the AFW system to operate the plant in hot standby for 4 hours followed by a 5 hour cooldown to 350°F (RHR cut-in temperature). Of the total tank capacity, a dedicated volume of 330,000 gallons in each tank is reserved for the AFW system. All piping connections to the tanks below an ~~elevation to store this capacity~~ are seismic Category I, Quality Group C. Instrument lines and the piping to the AFW pumps are heat traced to protect against freezing with alarms in the control room actuated by a 25 percent reduction in heater circuit current to indicate heater circuit failure. Protection of the tank contents from freezing is prevented by periodic operation of the degasifier system and the hotwell level control system, plus the inherent protection of the large volume of water combined with the tanks concrete construction. The tank water temperature is monitored and alarmed in the control room on low-temperature. Thus, the requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and the guidelines of Positions C.1 and C.2 of Regulatory Guide 1.29 are met.

~~Each unit has its own condensate storage facility consisting of two tanks with no sharing between units. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems, and Components" are satisfied.~~

The lines from each tank to the AFW system are redundant, with three separate lines (three AFW pumps) from each tank. The facility design meets the single failure criterion and can perform its function following a loss of offsite power. All nonseismic Category I portions of the system are designed such that their failure will not affect the seismic Category I portions of the system. The condensate storage facility for each unit has adequate capacity for the AFW system to perform its safety function under all postulated normal, transient and accident conditions. Thus, the requirements of General Design Criterion 44 "Cooling Water" are met.

The condensate storage facility is normally in operation and its safety function (supply to AFW system) is functionally tested with the monthly AFW pump tests in accordance with plant technical specifications. The facility components are accessible to permit periodic inservice inspection as required. Thus, the requirements of General Design Criteria 45 "Inspection of Cooling Water System," and 46, "Testing of Cooling Water System," are met.

Based on the above, we conclude that the condensate storage facility meets the requirements of General Design Criteria 2, 5, 44, 45, and 46 with respect to protection against natural phenomena, shared systems, decay heat removal function, inservice inspection and testing, and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2 with respect to design capability and seismic classification, and is therefore acceptable. The design of the condensate storage facility meets the acceptance criteria of SRP Section 9.2.6

9.3 Process Auxiliaries

9.3.1 Compressed Air System (and Auxiliary Gas System)

The compressed air system and auxiliary gas system were reviewed in accordance with Section 9.3.1 of NUREG-0800 (SRP). 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 compressed air and auxiliary systems with respect to the applicable regulations of 10 CFR 50.

The compressed air system is described in FSAR Section 9.3.1 and the auxiliary gas system is described in FSAR Section 9.3.5.

of the two reactor

Each units has its own compressed air system with a minimum of sharing. A total of seven compressors (4 rotary, 3 reciprocating) are provided that are powered from a combination of seven switchgear, with four switchgear associated with Unit 1 and three switchgear associated with Unit 2. Each rotary compressor train consists of an air intake filter, compressor, air/coolant receiver separator, after cooler, moisture separator, contaminant filter and an air receiver. Each reciprocating compressor train consists of an air intake filter, compressor, after cooler, moisture separator, and an air receiver. X

There are two rotary compressor trains and one reciprocating train located in each unit. The third reciprocating train is located in Unit 1 and is piped such that it can be aligned to either unit's supply system.

The compressed air supply system in each unit provides air to the instrument air system and the service air system. The service air system in each unit consists of a prefilter, a dryer and an after filter from which air flows to the various service air loops. The instrument air system in each unit consists of two dryers in parallel, each having a prefilter and an after filter from which air flows to the various instrument air loops in that unit.

The instrument air and service air system are not safety related and are classified nonseismic Category I, Quality Group D. Safety related instruments and controls that are supplied by the instrument air system are designed to fail in the safe position and do not require a source of air to perform their safety function.

Since the compressed air system is not safety related, electrical equipment is powered from nonsafety related motor control centers. And since the compressors are cooled by the turbine plant closed cooling water system, which is cooled by the turbine plant (open) cooling water system, ~~circulating water system~~, they are not available following a loss of offsite power. However, air storage receivers would keep the air supply system operable for a limited time period following a loss of offsite power.

The entire system, except for containment pentrations is nonseismic Category I. The containment penetrations, including isolation valves, are seismic Category I, Quality Group B. Failure of nonseismic Category I portions of the system will not prevent safe plant shutdown, affect the capability for accident mitigation or ~~and will not~~ result in the failure of seismic Category I structures, systems or components. 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.

Since the systems are not safety related, the requirements of General Design Criterion 5 "Sharing of Structures, Systems, and Components," are not applicable.

The instrument air system meets ISA-S7.3 "Quality Standard for Instrument Air," in that the equipment (air dryers and filters) was purchased to meet that standard (ISA-S7.3). Preoperational testing will be performed in accordance with Regulatory Guide 1.68.3 "Preoperational Testing of Instrument Air Systems," to verify the system meets the air quality requirements of ISA-S7.3.

The auxiliary gas systems, FSAR Section 9.3.5, provide hydrogen, oxygen and nitrogen gases to plant systems as required. None of the functions performed by systems served by the auxiliary gas systems are safety related. The nitrogen gas system is used to supply nitrogen for pressurizing, blanketing, and purging of various plant components. Hydrogen is used for the waste decay tanks, generator (turbine) cooling, oxygen scavenging in the chemical and volume control system, and testing of the hydrogen recombiners. The oxygen gas system supplies oxygen to the hydrogen catalytic recombiners of the gaseous waste processing system. The gas storage facilities are protected from external missiles and have been analyzed as potential missile sources. The storage tanks are located such that their failure will not cause diesel engine air starvation.

The auxiliary gas systems are not required for safe plant shutdown or to mitigate the consequences for an accident. They are, therefore, classified as nonseismic Category I, Quality Group D. Failure of the system will not cause failure of any seismic Category I systems, safe-shutdown systems, or systems necessary to mitigate the consequences of an accident. Thus, the requirements of General Design Criterion 2, and the guidelines of Regulatory Guide 1.29, Position C.2, are met.

Since the auxiliary gas systems have no safety functions, the requirements of General Design Criterion 5, regarding sharing, are not applicable.

Based on the above, we conclude that the compressed air system and the auxiliary gas systems meet the requirements of General Design Criterion 2 regarding seismic design, and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2, with respect to seismic classification, and are, therefore, acceptable. The compressed air system and the auxiliary gas systems, meet the applicable acceptance criteria of SRP Section 9.3.1.

9.3.3 Equipment and Floor Drainage System

The equipment and floor drainage system was reviewed in accordance with Section 9.3.3 of NUREG-0800 (SRP). 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 equipment and floor drainage system with respect to the applicable regulations of 10 CFR 50.

The equipment and floor drainage system, portions of which are safety related includes all piping and valves associated with equipment drains, floor drains, sumps, sump pumps and piping necessary to transfer potentially radioactive and nonradioactive effluent from the sumps to the appropriate waste processing system. Potentially radioactive effluent is collected in floor and equipment drain sumps in each building and discharged to the gaseous or liquid radwaste system for treatment and/or disposal.

The liquid radwaste collection system collects potentially radioactive liquid wastes from the equipment and floor drainage systems of the containment, control building, auxiliary building, fuel handling building, radwaste solidification building, and the radwaste transfer building. The turbine building drain system collects the normally nonradioactive effluent from floor drains, equipment drains, sampling wastes, and other miscellaneous drains in the turbine building. If the fluid becomes contaminated it is treated before discharge after being automatically diverted to the turbine building drain tank.

The control building drain system, fuel handling building and electrical tunnel drain system, the auxiliary building flood retaining room drain system, the auxiliary building and miscellaneous drain system (except for the nuclear service water chemical control building), and the containment and auxiliary building drain system are designed to seismic Category I requirements. The drain systems from engineered safety features (ESF) pump rooms are designed to prevent flooding of ESF equipment via backflow through drainage piping by having normally closed seismic Category I isolation valves. Safety-related seismic Category I redundant leakage detection is also provided in each of the ESF pump rooms by a high level detector in the floor drain box and a wall mounted level detector to act as a backup. Drainage lines from negative pressure boundary areas that terminate outside the negative pressure boundary are provided with a locked closed isolation valve or water seal which are designed to seismic Category I requirements. The seismic Category I portions of the system are also located in seismic Category I flood and tornado protected structures. 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" are met. Portions of the system that are not seismic Category I are seismically supported such that their failure will not affect seismic Category I structures, systems and components in accordance with Position C.2 of Regulatory Guide 1.29.

The ESF equipment rooms and other safety-related areas are protected against flooding due to backflow through the drain system by having separate Train A and Train B drainage systems. The ESF pump rooms also have locked closed isolation valves in the drains from each room, while other safety-related areas are equipped with check valves in the drain lines. The control building drains from some Train A and Train B areas are adequately sloped and drain into a common header. The common header arrangement is acceptable because there are no significant water sources in the areas. Watertight doors (refer to Section 3.4.1 of this SER) are provided for ESF equipment rooms as necessary, to protect against flooding between rooms, flooding from outside areas, and to prevent the spread of post-LOCA contamination. [The applicant has not completed the analyses to determine all areas that will require watertight doors. We, therefore, cannot make a determination with respect to General Design Criterion 4 "Environmental and Missile Design Bases," with respect to the effects of flooding.]

The equipment and floor drainage system's potentially radioactive drainage is collected by separate systems other than the non-potentially radioactive drainage collection systems. Potentially radioactive drainage is collected in floor and equipment drain sumps in each building and discharged to the radwaste processing system. Thus, the requirements of General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," are met. ×

Separate equipment and floor drainage systems are provided for each unit except for the fuel handling building that is shared by both units. Failure of the system in this area will not affect safe plant shutdown nor increase the consequences of a fuel handling accident to conditions worse than those that would exist for a single unit. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are satisfied.

Based on the above, we conclude that the equipment and floor drainage system meets the requirements of General Design Criteria 2, 5, and 60 regarding protection against natural phenomena, sharing, and prevention of radioactive releases, and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2 regarding seismic classification. [Until the applicant completes the flooding analysis and determines the location of all watertight doors we cannot make a determination with respect to General Design Criterion 4 regarding flooding. We, therefore, cannot conclude that the system meets the acceptance criteria of SRP Section 9.3.3.]

9.4 Heating, Ventilation and Air Conditioning (HVAC) Systems

9.4.1 Control Room Area Ventilation System (Control Building Ventilation Systems)

The control building ventilation systems were reviewed in accordance with Section 9.4.1 of NUREG-0800 (SRP). 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 complex ventilation systems with respect to the applicable regulations of 10 CFR 50.

The control building (normal and emergency) HVAC systems are designed to maintain a suitable environment for equipment operation in the control building and safe occupancy of the control room under all plant conditions. The control building HVAC systems are made up of various subsystems that serve the control room area, battery rooms, control building laboratory and service areas, cable spreading rooms, electrical equipment rooms, the central alarm station (security) and the locker, shower and toilet areas. Refer to Section 6.4 of this SER for further discussion of control room habitability.

The control building normal HVAC subsystems consist of the control building normal supply and exhaust systems, the control room HVAC system, the engineered safety features (ESF) electrical equipment rooms HVAC system, and the electrical penetration areas filtration and exhaust system. The safety-related ESF electrical equipment rooms HVAC system is evaluated in Section 9.4.5 of this SER.

The control building normal supply and exhaust systems include the following: control room normal HVAC, control building normal HVAC, equipment and electrical equipment rooms HVAC, central alarm station backup HVAC, control building locker and toilet exhaust, control building laboratory hood vent, cable spreading rooms HVAC, and the onsite technical support center HVAC. These normal ventilation systems serve no safety function since they are not necessary for safe shutdown or to mitigate the consequences of an accident or transient. However, the ductwork for all these systems is designed to maintain structural integrity following a safe shutdown earthquake such that its failure will not affect any safety-related equipment or seismic Category I structures, systems or components. These systems, therefore, meet Position C.2 of Regulatory Guide 1.29 "Seismic Design Classification" and the requirements of General Design Criterion 2 "Design Bases for Protection Against Natural Phenomena," as they relate to protection against seismic events.

The control room normal HVAC system includes two 100 percent capacity air handling units, two 100 percent return and exhaust fans, ductwork with dampers and associated controls, electric duct heaters and one exhaust fan serving the toilet, kitchen, conference room, and janitor rooms. There are two outside air intakes located on the east and west walls of the control building that are tornado missile protected and provided with tornado dampers. The control room normal HVAC system is designed to maintain the control room at a positive pressure, nominally 1/8 inch water gage (WG), to prevent infiltration.

The cable spreading rooms HVAC systems provide normal ventilation and air-conditioning for the cable spreading rooms, auxiliary relay rooms, computer rooms, and the HVAC equipment area, and are also a means of smoke removal for the cable spreading rooms. The systems have two full-capacity supply units for each level of the control building served and one smoke exhaust fan. Each supply unit consists of a prefilter, fan and cooling coil (normal chilled water) with ductwork.

The normal HVAC equipment and electrical equipment rooms HVAC system consists of two fans and two heaters for the HVAC equipment rooms and one air-conditioning unit, one heater and one exhaust fan for the electrical equipment rooms. The safety-related HVAC for the electrical equipment rooms and cable spreading rooms are ~~further~~ discussed in Section 9.4.5 of this SER.

The control room emergency (essential) ventilation and air-conditioning (HVAC) system is separated from the normal HVAC systems by automatic air-operated, redundant, seismic Category I isolation dampers that are designed to fail closed on loss of air or loss of power to the solenoids. The essential HVAC system consists of two redundant and physically separated, full-capacity, air handling unit trains, each with a moisture eliminator, electric preheater, high-efficiency particulate air (HEPA) filters and charcoal adsorbers. Although there is a combined control room for both units, there are separate redundant essential systems for each unit's area of the control room which is divided down the middle. The only portion of the essential HVAC systems that are shared between units are the two control building air intake plenums and exhaust plenums. The cooling coils for the air handling units are supplied by separate trains of the essential chilled water system (SER Section 9.2.2). The control room essential HVAC system maintains the control room at a positive 1/8-inch WG pressure during the emergency mode of operation.

The essential control room HVAC system is located in seismic Category I, flood and tornado protected structures. The system itself is designed to seismic Category I requirements including redundant isolation dampers at connections to the normal, nonsafety-related, HVAC systems. The intake and exhaust plenums are protected against tornado missiles and tornado dampers are provided. Thus, the requirements of General Deisgn Criterion 2, and the guidelines of Regulatory Guide 1.29, Position C.1, are satisfied.

The normal and essential control room HVAC systems are capable of maintaining environmental conditions in the control room compatible with the design limits of essential equipment located therein during normal, transient, and accident conditions. ~~During all modes of operation the control room is maintained between 70°F and 80°F with a maximum relative humidity of 50 percent~~. Thus, the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," are satisfied.

Each unit has a separate, redundant control room essential HVAC system with the only sharing between units being the intake and exhaust plenums with associated ductwork and isolation dampers. All four (two per unit) HVAC trains can take suction from either of the two intake plenums such that a single failure would not prevent operation of either train for either unit.

The exhaust plenum is not necessary for emergency operation (recirculation) so its sharing does not impair any safety function. Within the trains a single failure could only affect that train of the one unit since components within the trains are not shared. Portions of some nonessential HVAC systems serving the control building during normal operation involve a small degree of sharing, but such sharing does not affect any safety function of the control building HVAC systems. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems, and Components," are satisfied where applicable.

During normal operations the control room normal HVAC system is operating to maintain the control room environment within design limits. In the event of high radiation detection, chlorine detection, loss of offsite power, or a safety injection signal the normal HVAC system is automatically isolated and the essential HVAC system is automatically initiated. The essential system can also be manually initiated from the control room. There are redundant safety-related radiation detectors for each HVAC intake. Upon detection of high radiation or a safety injection signal the essential HVAC system (both trains) start in the emergency mode. In the emergency mode the normal HVAC system is isolated and positive pressure is maintained in the control room by a combination of outside air intake and recirculation. All outside air is filtered through the essential filtration units in this mode. There are also redundant Class 1E chlorine detectors for each outside air intake. Upon detection of chlorine at the intake, the essential HVAC system starts and operates in the isolation (toxic gas) mode. In the isolation mode the normal HVAC system is isolated from the essential system, the outside air intakes are isolated and the essential system operates with full recirculation through the air-handling units. In this mode, zero differential pressure is maintained between the control room and outside areas. There are also redundant smoke detectors for each air intake. Upon detection of smoke at the intake, an alarm in the control room alerts the operator and the control room HVAC systems are manually shifted to the isolation mode. The habitability conditions during these modes are further discussed in Section 6.4 of this SER.

The automatic isolation provisions provided by the redundant chlorine detection system meet the guidelines of Regulatory Guides 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.4a and C.4d. Thus, the requirements of General Design Criterion 19 "Control Room," with respect to maintaining a suitable environment during normal and accident conditions, are met, since as described above, the operators are also protected against radiation and smoke.

The emergency air filtration trains for the control room are 100 percent redundant and are physically separated so that a single event cannot damage both units. All essential components of the system are designed to seismic Category I requirements. The air filtration (atmosphere cleanup) systems are not subjected to any pressure surges as a result of postulated accidents. Tornado dampers are installed to protect against negative pressure surges due to tornadoes or high winds. Each train has a design volumetric air flow rate of 25,000 cubic feet per minute (CFM) which is 5,000 CFM less than the maximum ~~recommended~~ allowed by Position C.2 of Regulatory Guide 1.52 "Design, Testing, and Maintenance Criteria for ESF Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants." Instrumentation for pertinent temperatures, flows and pressure diffentials are provided and alarm in the control room upon detection of high temperature, low flows, and high/low differential pressures. Each train is powered from a separate emergency bus and the essential instrumentation and controls are safety grade. ∝

The above description constitutes compliance with Position C.2 of Regulatory Guide 1.29. Thus, the requirements of General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," as they may relate to filter system designs. The applicant has also indicated compliance with 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. Based on the above, we conclude that the control building ventilation systems are in conformance with the requirements of General Design Criteria 2, 4, 5, 19, and 60 relating to protection against natural phenomena, maintaining proper environmental limits for equipment operation, shared systems, occupancy of the control room under normal and accident conditions, and the design of the filtration systems to limit radioactivity. We further conclude that the systems meet the guidelines of Regulatory Guides 1.29, Positions C.1 and C.2, 1.52, Position C.2, 1.78, Positions C.3, C.7 and C.14, 1.95, Positions C.4a and C.4d and 1.140, Positions C.1 and C.2 relating to seismic classification, design capability of the filtration system, design for protection against hazardous chemicals including chlorine, and the design for normal plant operation. We, therefore, conclude the control building ventilation systems are acceptable and the acceptance criteria of SRP Section 9.4.1 are met.

With regards to Unit 1 operation while Unit 2 is still under construction we will review the technical specifications for Unit 1 to ensure complete isolation from the Unit 2 HVAC systems prior to issuance of an OL for Unit 1.

9.4.2 Spent Fuel Pool Area Ventilation System (Fuel Handling Building Ventilation Systems)

The fuel handling building ventilation system was reviewed in accordance with Section 9.4.2 of NUREG-0800 (SRP). 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. Conformance with the acceptance criteria formed the basis for our evaluation of the fuel handling building ventilation system with respect to the applicable regulations of 10 CFR 50.

The fuel handling building (FHB) heating and ventilation system consists of a nonsafety related normal heating and ventilation subsystem and a safety-related emergency (ventilation) subsystem to limit potential radioactive release to the atmosphere during accident conditions and to provide safety-related cooling for the spent fuel pool heat exchanger and pump rooms.

The normal FHB ventilation system is designed to maintain the FHB at a suitable temperature and environment, maintain a negative pressure (1/4 inch WG), and minimize the release of radioactivity to the environment during normal plant operations, maintenance, testing, and periods of general personnel access. The normal FHB ventilation system only functions during normal operational modes including fuel handling operations. Upon detection of high radiation in the exhaust ductwork or low differential pressure between the FHB and atmosphere, the normal FHB ventilation system automatically isolates and the emergency FHB ventilation system automatically starts providing post-accident filtration, safety-grade cooling of the fuel pool heat exhanger and pump rooms, and maintaining a negative 1/4 inch WG pressure in the FHB.

The normal FHB ventilation system supplies filtered conditioned air to the FHB and processes the exhaust air through filter trains prior to discharge through the Unit 1 plant stack. The normal FHB ventilation system consists of two 100-percent air handling units, reheat coils, two 100-percent exhaust units, two recirculating air units serving the spent fuel pool area, one recirculating air unit serving the [illegible] corridor, and associated piping, ductwork, dampers, registers, and controls. Also during normal operation the recirculation units in each of the spent fuel pool heat exchanger and pump rooms receive cooling water from the normal chilled water systems.

The emergency or post-accident FHB ventilation system provides post-accident filtration of the FHB exhaust prior to discharge through the Unit 1 plant stack. The emergency FHB ventilation system consists of two 100-percent exhaust filtration units, two cooling recirculation units per plant unit in the spent fuel pool heat exchanger and pump rooms, and associated piping, ductwork, dampers and controls. The recirculaton units in the spent fuel pool heat exchanger pump rooms each contain two cooling coils. One cooling coil is supplied by the nonsafety-grade normal chilled water system for normal operation while the other cooling coil is supplied by the safety-related essential chilled water system for emergency and post-accident operation.

The normal FHB ventilation system is not safety related but the ductwork is designed to maintain its structural integrity following a safe shutdown earthquake such that it cannot fail and damage seismic Category I equipment. Redundant seismic Category I isolation dampers that isolate the normal FHB system from the negative pressure boundary or from the emergency FHB ventilation system are provided to automatically isolate the normal system under emergency or accident (fuel handling) conditions. The emergency FHB ventilation system including necessary instrumentation and controls, isolation dampers and ductwork are designed to seismic Category I requirements and are located in seismic Category I flood and tornado protected structures. The plant vent or stack to which the emergency system exhausts, including the connecting ductwork are also designed to seismic Category I requirements. Thus, the guidelines of Regulatory Guide 1.29 "Seismic Design Classification, Positions C.1 and C.2, and the requirements of General Design Criterion 2 "Design Bases for Protection Against Natural Phenomena," are satisfied.

Since the fuel handling building is common to both units, portions of the emergency FHB ventilation system are shared. The normal FHB ventilation system and the filtration units of the emergency FHB ventilation system each consists of two trains which serve the common area of the FHB. The recirculation units serving the spent fuel pool heat exchanger and pump rooms are not shared during normal or emergency conditions since each unit has its own spent fuel pool cooling system. Sharing of the normal FHB ventilation system is acceptable since the system has no safety function and a single failure of the isolation system does not affect the capability to isolate the normal FHB ventilation system during emergencies. The emergency filtration system is fully redundant including the isolation capabilities, and a single failure following a fuel handling accident will not result in greater radiological releases than if the system was serving one unit. The ability of the emergency FHB ventilation system to perform its safety function is not impaired by the sharing and the system is not necessary for safe plant shutdown. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems, and Components," are satisfied.

The guidelines of Regulatory Guide 1.13 "Spent Fuel Storage Facility Design Basis," Positions C.1, C.4 and C.7 are met since the emergency FHB ventilation system is seismic Category I, provides post-accident filtration while maintaining a negative pressure and is automatically initiated by a high radiation signal. The guidelines of Regulatory Guide 1.52, "Design, Testing and Maintenance Criteria for Post-Accident ESF Filtration and Adsorption Units for Light-Water-Cooled Nuclear Power Plants," Position C.2 are satisfied by the design of the emergency filtration units since they are redundant, seismic Category I, physically separated, protected against pressure surges by tornado dampers, instrumented to alarm in the control room, powered by the emergency power supplies, designed to allow maintenance, and do not exceed the maximum flow rate recommended by Position C.4f. The normal FHB ventilation system is designed to meet the guidelines of Positions C.1 and C.2 of Regulatory Guide 1.140, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration Units of Light-Water-Cooled Nuclear Power Plants," since the system is adequately isolated from the emergency system, provided with inlet filters, designed with adequate filtration to reduce releases of radioactive material during normal operation and provided with adequate instrumentation and alarm. Based on the above the requirements of General Design Criteria 60, "Control of Releases of Radioactive Materials to the Environment," and 61 "Fuel Storage and Handling and Radioactivity Control," are satisfied.

Based on the above, we conclude that the fuel handling building ventilation system is in conformance with the requirements of General Design Criteria 2, 5, 60, and 61 as they relate to protection against natural phenomena, control of releases of radioactive materials, and radioactivity control, and the guidelines of Regulatory Guides 1.13, Positions C.1, C.4, and C.7, 1.29, Positions C.1 and C.2, 1.52, Position C.2, and 1.140, Positions C.1 and C.2, relating to protection against radioactive releases, seismic classification, and system design for emergency and normal operation, and is, therefore, acceptable. The fuel handling building ventilation system meets the acceptance criteria of SRP Section 9.4.2.

9.4.3 Auxiliary and Radwaste Buildings Ventilation Systems

The auxiliary and radwaste buildings ventilation systems were reviewed in accordance with Section 9.4.3 of NUREG-0800 (SRP). 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 and radwaste buildings ventilation systems with respect to the applicable regulations of 10 CFR 50.

The auxiliary building (AB) is provided with two ventilation systems, the AB normal ventilation system and the AB emergency ventilation system. The radwaste buildings have their own separate ventilation systems for the radwaste (RW) transfer building, RW transfer tunnel, RW solidification building and control room, health physics building and RW electrical switchgear/motor control center (MCC) room.

The nonsafety-related AB normal ventilation system draws outside air through air handling units that filter and condition the air before distribution to the various equipment rooms, switchgear rooms, and access areas in the auxiliary building. Air is also supplied to the piping penetration area where it is distributed to the various valve galleries and penetration rooms. The air is collected through return registers and ducted to the exhaust filtration units, where it is filtered and discharged to the plant vent. Although the normal ventilation system is not safety related the ductwork is designed to maintain its integrity following a safe shutdown earthquake (SSE) such that it cannot fail and damage seismic Category I equipment in accordance with Position C.2 of Regulatory Guide 1.29 "Seismic Design Classification." The system consists of two full capacity air supply units, three half-capacity exhaust filtration units and associated ductwork, piping, dampers, registers plus instrumentation and controls.

The AB emergency ventilation system includes those components which function after an accident/emergency to keep ESF equipment rooms cooled, maintain a negative pressure on the areas to prevent releases of radioactivity to the atmosphere, and filter the exhaust from the negative pressure boundary. The AB emergency ventilation system is comprised of two subsystems which are the ESF room coolers and the piping penetration area filtration and exhaust ~~area~~ system.

The AB emergency ventilation system consists of two full-capacity exhaust filtration units for the piping penetration area, two full capacity piping penetration area coolers, and individual full capacity recirculating fan coolers for each of the ESF rooms. One of the penetration area coolers is cooled by nuclear service water and the other by the essential chilled water system. Each cooler has two coils, one of which is supplied by Train A water, the other by Train B water. The ESF room coolers are supplied water from the essential chilled water systems. The room coolers in the electric switchgear rooms, RHR pump rooms, charging pump rooms and the spent fuel pool heat exchanger and pump rooms, also have a second cooling coil that is supplied by the normal chilled water system.

The radwaste (RW) buildings ventilation systems are not safety related and are designed to maintain suitable conditions for personnel safety in access areas, for equipment operation and to prevent the spread of airborne radioactivity in the buildings. Airflow is maintained from lower to higher radioactivity areas. The various individual subsystems consist of prefilters, chilled water cooling coils, air supply units, heating coils, HEPA filters, carbon adsorbers, exhaust fans, liquid chillers, chilled water pumps and humidifiers. There are no safety-related or seismic Category I equipment located in proximity to the RW buildings ventilation systems, therefore, a failure of the system due to a seismic event will not result in damage to safety-related or seismic Category I equipment in accordance with Position C.2 of Regulatory Guide 1.29.

The AB emergency ventilation system is designed to seismic Category I requirements and it is located within seismic Category I flood and tornado protected structures. Isolation dampers between the AB normal and emergency ventilation systems are redundant and seismic Category I. As described above, the AB normal and radwaste buildings ventilation systems cannot fail so as to damage seismic Category I equipment. Thus, the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2, and the requirements of General Design Criterion 2 "Design Bases for Protection Against Natural Phenomena" are satisfied.

The AB normal and emergency ventilation systems are not shared between units. Since there is only one radwaste facility for both units, the radwaste buildings ventilation systems are shared between units. However, since this system has no safety function and its failure cannot affect safe shutdown of either unit, this sharing is acceptable. Thus, the requirements of General Design Criterion 5 "Sharing of Structures, Systems and Components," are satisfied.

The AB normal ventilation system and the radwaste buildings ventilation systems have exhaust filtration units that are provided with HEPA and carbon adsorbers to reduce the amount of radioactivity released during normal plant operations that are designed in accordance with Positions C.1 and C.2 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." The AB emergency ventilation system has redundant safety-grade exhaust filtration units that are equipped with HEPA and carbon adsorbers to reduce the amount of radioactivity released from areas of potential radioactivity (ESF rooms / penetration rooms) following an accident. These filtration units are designed ~~(with an acceptable minor alternative regarding replacement)~~ in accordance with Position C.2 of Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," regarding functional design. Thus, the requirements of General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," are met.

The essential penetration area coolers and the individual ESF room coolers are designed to maintain the essential equipment served by these coolers within the required environmental design limits during transient and accident conditions. During normal operating conditions these areas are maintained within environmental limits by the AB normal ventilation system or by the ESF room coolers supplied by normal chilled water. The ESF equipment room coolers are automatically started by a safety injection signal, ~~when~~ the pump in its respective room starts or they can be started manually from the control room. Following a loss of offsite power these coolers are powered by the emergency Class 1E power supplies. Thus, the requirements of General Design Criterion 4 "Environmental and Missile Design Bases," are satisfied regarding environmental conditions.

Based on the above, we conclude that the auxiliary and radwaste buildings ventilation systems are in conformance with the requirements of General Design

Criteria 2, 4, 5, and 60 as they relate to protection against natural phenomena, maintaining an acceptable environment, shared systems, and control of release of radioactive materials to the environment, and the guidelines of Regulatory Guides 1.29, Positions C.1 and C.2, 1.140, Positions C.1 and C.2, and Regulatory Guide 1.52, Position C.2 relating to seismic classification and system design for normal and emergency operation and are, therefore, acceptable. The ventilation systems meet the acceptance criteria of SRP Section 9.4.3.

9.4.4 Turbine Area Ventilation Systems

The turbine building area ventilation systems were reviewed in accordance with Section 9.4.4 of NUREG-0800 (SRP). 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 area ventilation systems with respect to the applicable regulations of 10 CFR 50.

The turbine building area ventilation systems consist of independent systems for each unit within the common turbine building. Each includes air intake louvers in the lower outside walls and roof exhaust fans discharging to the environment. Individual rooms within the turbine building have air conditioning and heating equipment where necessary. Since none of the systems are safety-related the requirements of General Design Criterion 5, "Sharing of Structures, Systems, and Components," are not applicable.

The system is classified as nonsafety related (nonseismic Category I, Quality Group D). The system maintains an acceptable environment for personnel and the nonessential equipment served during normal plant operations. 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, and thus it meets 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.2. The system is provided with filtration systems having HEPA filters and charcoal bed filters that are automatically placed into operation to filter any contaminated air discharged from the steam jet air ejectors, vacuum pumps, and turbine gland seals upon detection of high radiation in the exhaust from these areas. These filter trains are designed in accordance with the guidelines of Positions C.1 and C.2 of Regulatory Guide 1.140 "Design, Testing and Maintenance Criteria for Normal Ventilation System Air Filtration and Adsorption Units for Light-Water-Cooled Nuclear Power Plants." Thus, the requirements of General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," are satisfied.

Based on our review, we conclude that the turbine building ventilation system meets the requirements of General Design Criterion 2 and 60 with respect to the need for protection against natural phenomena and control of the release of radioactive materials, and the guidelines of Regulatory Guides 1.29, Position C.2, and 1.140, Positions C.1 and C.2 concerning its seismic classification, and filtration capability, and is, therefore, acceptable. The turbine building 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 NUREG-0800 (SRP). 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 of Section 9.4.5 formed the basis for our evaluation of the engineered safety features ventilation systems with respect to the applicable regulations of 10 CFR 50.

The ESF ventilation systems include the auxiliary building ESF system, control building ESF system, diesel generator (DG) building ventilation, and auxiliary feedwater (AFW) pumphouse ventilation systems. The auxiliary building ESF ventilation systems are part of the auxiliary building emergency ventilation system which is described and evaluated in Section 9.4.3 of this SER. The DG building and AFW pumphouse ventilation systems are described in Sections 9.4.7 and 9.4.8 of the applicants FSAR and are evaluated in this section of the SER as described below.

The control building ESF ventilation system is comprised of three subsystems, the safety feature electrical equipment room HVAC system, the electrical penetration filter exhaust system and the ESF HVAC equipment room ventilation system.

The control building safety feature electrical room HVAC system operates during normal, transients and accident conditions. It consists of two independent full-capacity trains for level B of the control building and two independent full capacity recirculation units for the auxiliary relay rooms. Each full capacity train at level B includes an air-conditioning unit with a pre-filter, two cooling coils, fan and associated ductwork, instrumentation and controls. One of the cooling coils is supplied by the normal chilled water system and the other is supplied by the essential (ESF) chilled water system. The auxiliary relay room coolers receive cooling water from the essential chilled water system. During normal operation the auxiliary relay rooms are cooled by the cable spreading room normal ventilation system (Section 9.4.1 of this SER). Redundant 100 percent capacity battery room exhaust fans are also provided as part of the control building safety feature electrical room HVAC system. There are four safety related battery rooms per unit in the control building, two 100 percent capacity fans serve one pair of rooms, with no sharing between units.

The electrical penetration room filter exhaust system which operates automatically following a containment ventilation isolation signal, consists of two full capacity filtration units, each having a moisture eliminator, heating coil, two HEPA filters, charcoal filter and fan. Each train has sufficient capacity to exhaust both A and B penetration rooms. X

The control building ESF HVAC equipment room ventilation system includes two common intake ducts that provide air to the filter and chiller rooms for each train associated with the two units and an independent exhaust fan (4) for each chiller room.

The diesel generator (DG) building ventilation system includes an ESF system and a non-ESF system. The ESF system operates during diesel operation and the non-ESF system operates when the diesel is shut down. The non-ESF system consists of 10 unit heaters, one exhaust fan with a motor operated backdraft damper and associated instrumentation and controls for each diesel generator room. The ESF system consists of two 50-percent capacity supply fans, two air inlets and outlets, and discharges/intake openings in the penthouse for each diesel generator room. Each opening is provided with automatic motor operated dampers for flow and temperature control. One of the 50 percent capacity ESF exhaust fans start when the diesel starts and the other starts on a high temperature of 90°F in the DG building.

The AFW pumphouse HVAC system is comprised of the normal and essential HVAC systems that provide a suitable environment for equipment operation during normal, accident and transient conditions. The AFW pumphouse HVAC system for each unit consists of three outside air supply fans equipped with motor operated shutoff dampers, four recirculating air unit heaters and one outside air inlet with a pneumatically operated shutoff damper. Each motor driven pump room has an ESF supply fan and damper and a non-ESF heater. The turbine driven pump room has a non-ESF air supply fan and damper, two non-ESF heaters, and an ESF air-operated outside air damper that fails open and opens when the turbine driven AFW pump starts. When the non-ESF supply fan is not operating the turbine driven AFW pump room is maintained within environmental design limits by natural convection.

Essential portions of the ESF ventilation systems are designed to seismic Category I requirements and are located in seismic Category I, flood and tornado protected structures. Nonessential portions of the ESF ventilation systems are seismically supported such that they will not fail due to a safe shutdown earthquake and damage seismic Category I equipment. All air inlet and exhaust openings are provided with tornado missile protection. 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.

Each train of the ESF ventilation systems is powered from the same Class 1E emergency bus as the equipment which it serves. The ESF ventilation system is designed to meet the single failure criterion in that a single failure can only affect one train. The ESF ventilation systems are designed to maintain environmental conditions within essential equipment operating conditions during normal, accident and transient conditions. Thus, the requirements of General Design Criterion 4, "Environmental and Missile Design Bases," are satisfied.

Each unit has its own independent, redundant systems. The only sharing that occurs in the ESF ventilation systems is the common intake to the control building filter rooms and the common intake to the control building chiller rooms. There are no active components in the intake systems that are shared. Therefore, a single active failure cannot affect the systems operation. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems, and Components," are met.

General Design Criterion 17 "Electric Power Systems," requires in part, that the onsite power system be designed to minimize the probability of system failure. To meet this requirement the applicant was requested to meet the guidelines of Item 2, Subsection A and Item 1, Subsection C, of the "recommendations" section of NUREG-CR/0660 "Enhancement of Onsite Emergency Diesel Generator Reliability," which relate to the accumulation of dust and particulate materials. The combustion air intakes and emergency ventilation air intakes are in accordance with Item 1, Subsection C in that they are both greater than 20 feet above the ground level and have separate intake systems. The normal ventilation intake is only three feet above the ground and does not include any filtering system. In lieu of filters in the normal intakes the applicant, in Amendment 9 to the FSAR, stated that all electrical cabinets that could be affected by dust (contacts, relays) are dust proof except for the engine and generator control panel enclosures. The engine and generator control panel enclosures are NEMA 12 design with filtered louvers for natural ventilation. However, openings are provided on the bottom of the enclosures to facilitate installation of electrical cables and pneumatic tubing. The applicant further states that the normal air intakes are also designed to minimize the entry of dust since they are covered by missile protection cubicles with bottom entry of air and have low air flowrates through the intakes of approximately 5.6 cubic feet per minute (CFM). [The FSAR flow diagrams for the D/G ventilation systems show a flowrate of greater than 16,000 CFM during the normal ventilation mode. The applicant has also not indicated why the openings on the bottom of the control panels remain open after the final installation of cables and tubing. We therefore cannot conclude that the recommendations of NUREG/CR-0660 are satisfied and are unable to make a determination regarding the requirements of General Design Criterion 17.]

The only filtration system associated with the ESF ventilation systems is the electrical penetration filter exhaust system which does not operate during normal plant operation. Therefore the guidelines of Regulatory Guide 1.140 "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units for Light-Water-Cooled Nuclear Power Plants," are not applicable. The electrical penetration filter exhaust system is fully redundant, seismic Category I, powered from the Class 1E emergency busses, physically separated and adequately instrumented and alarmed in accordance with Position C.2 of Regulatory Guide 1.52 "Design, Testing and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants." Thus, the requirements of General Design Criterion 60 "Control of Release of Radioactive Materials to the Environment," are satisfied.

Based on the above review we conclude that the engineered safety features ventilation systems are in conformance with the requirements of General Design Criteria 2, 4, 5 and 60 as they relate to protection against natural phenomena, assurance of proper environment for essential equipment, shared systems and control of radioactive releases, and meet guidelines of Regulatory Guides 1.29 (Position C.1 and C.2) as they relate to seismic classification. [We cannot conclude that the diesel generator system meets the guidelines of NUREG/CR-0660 regarding the accumulation of dust and particulate matter, and therefore we cannot make a determination regarding General Design Criterion 17 and the acceptance criteria of SRP Section 9.4.5.]

9.4.6 Miscellaneous Heating; Ventilation, and Air-Conditioning (HVAC) Systems (FSAR Section 9.4.9)

There is no section of the Standard Review Plan (SRP) NUREG-0800 which provides guidelines for miscellaneous HVAC systems. Since some of these systems are safety related, the guidelines of Section 9.4.5 were used for reviewing these systems. 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 9.4.5, except as noted below, formed the basis for our evaluation of the miscellaneous HVAC systems with respect to the applicable regulations of 10 CFR 50.

The miscellaneous systems reviewed include the nonsafety-related equipment building ventilation system, the safety-related electrical tunnel ventilation system, and the nonsafety-related piping penetration ventilation system.

The equipment building ventilation system consists of roof ventilators, and fans, tendon gallery supply fan, electric heaters with fans, dampers and associated piping, ductwork and controls. The system is not necessary for safe shutdown or to mitigate the consequences of an accident. The only safety-related equipment in the equipment building is the plant vent and associated safety-related ductwork to the plant vent which do not require ventilation to perform their safety function. Therefore, the only acceptance criterion of SRP Section 9.4.5 applicable to this system is General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," as it relates to failure of nonseismic Category I systems and their affects on seismic Category I systems. There are no failures of the equipment building ventilation system that could affect seismic Category I systems since there is essentially no ductwork and the other components are adequately separated from essential equipment. Therefore, the system meets the guidelines of Position C.2 of Regulatory Guide 1.29 "Seismic Design Classification," and the requirements of General Design Criterion 2 are satisfied.

The piping penetration ventilation system cools the main steam and feedwater restraints in the main steam and feedwater valve rooms of the control and auxiliary buildings and the main steam tunnels. The system is not necessary for safe shutdown or to mitigate the consequences of an accident. The piping restraints in the main steam and feedwater rooms of the control building are provided with redundant 100 percent capacity fans capable of being powered from the non-Class 1E, standby power system. In the auxiliary building the main steam and feedwater piping restraints for each train are provided with two 50-percent capacity fans. In the tunnels the main steam piping restraints are cooled by one fan. These fans are also capable of being powered from the non-Class 1E standby power system. The system is designed to maintain the concrete surrounding the restraints to below 200°F. As described above for the equipment building system the only acceptance criterion applicable to the piping penetration ventilation system is General Design Criterion 2. In accordance with the guidelines of Regulatory Guide 1.29, Position C.2, a seismically induced failure of the system will not result in damage to seismic Category I systems. Thus, the requirements of General Design Criterion 2 are satisfied.

The applicable acceptance criteria of SRP Section 9.4.5 for the electrical tunnel ventilation system are General Design Criteria 2, 4, "Environmental and Missile Design Bases," and 5, "Sharing of Structures, Systems, and Components." The remaining Section 9.4.5 acceptance criteria are not applicable as they relate to diesel generator operation and filtration and adsorption units which are not required for the electrical tunnel ventilation system.

The electrical tunnel ventilation system provides ventilation in the tunnels housing train-oriented (safety-related) and/or normal (nonsafety-related) cables. Each tunnel is served by its own subsystem.

Each tunnel ventilation system consists of one 100-percent capacity ventilation fan, fan housing, intake angle filter box with screen, and associated ductwork. The tunnels serviced per unit, are the two diesel power cable tunnels (Trains A & B), the two nuclear service cooling water (NSCW) tower cable tunnels (A & B), the turbine and auxiliary building Train A tunnel, and the turbine building chase to control building tunnel. The turbine and auxiliary building Train B tunnel is naturally ventilated by natural convection and no ventilation system is required.

The turbine building chase to control building tunnel is not safety-related and, therefore, not designed to seismic Category I requirements. A failure of this system due to a seismic event will not damage seismic Category I equipment and will not prevent safe plant shutdown in accordance with the guidelines of Regulatory Guide 1.29, Position C.2. The remaining tunnel ventilation systems are safety related, designed to seismic Category I requirements, and located in seismic Category I, flood and tornado protected structures. Tornado missile protection is provided for the ventilation intakes and exhausts. Thus, the requirements of General Design Criterion 2, and the guidelines of Regulatory Guide 1.29, Position C.1 are satisfied.

Since each train oriented tunnel has its own ventilation system, the system is single failure proof since only one train can be affected by single failures.

The ventilation systems for each tunnel are physically separated such that missles from one cannot affect another. Each safety-related tunnel ventilation system is powered by the Class 1E standby power system and has sufficient cooling capacity to maintain the cable tunnels at or below 104°F. High temperature in any tunnel is alarmed in the control room. The turbine building and auxiliary building tunnels are also provided with a low temperature alarm in the control room. Thus, the requirements of General Design Criterion 4 are met.

Each unit has its own set of tunnels and tunnel ventilation system with no sharing. Thus, the requirements of General Design Criterion 5, are satisfied. FP Based on the above, we conclude that the electrical tunnel ventilation system meets the requirements of General Design Criteria 2, 4, and 5, as they relate to protection against natural phenomena, maintaining environmental conditions within design limits, and sharing, and the guidelines of Regulatory Guide 1.29, Positions C.1 and C.2. We further conclude that the equipment building ventilation and piping penetration ventilation systems meet the requirements of General Design Criterion 2 regarding protection against earthquakes, and the guidelines of Regulatory Guide 1.29, Position C.2, regarding seismic design classification. We, therefore, conclude that the miscellaneous ventilation systems are acceptable and meet the applicable acceptance criteria of SRP Section 9.4.5.

10.3 Main Steam Supply System (Up to and Including the Outboard MSIV)

The main steam supply system was reviewed in accordance with Section 10.3 of NUREG-0800 (SRP). 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. X

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 (FSAR Sections 10.1 and 10.3) 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 four steam generators is conveyed in four separate main steam lines through the main steam isolation valves (MSIVs), combined into two main steam headers (38 inch and 36 inch) and then each header branches into two 28 inch lines, each of which goes to a turbine stop valve. The two main steam headers are cross-connected by two 20-inch lines just prior to their splitting into the four lines to the turbine. Each of the four main steam lines contains two MSIVs. The sizing of the 38 and 36 inch headers hydraulically balances the steam line pressure drops from the respective pair of steam generators to the inlet of each of the turbine stop valves. This balancing was necessary since the main steam outlets from each pair of generators are widely separated with containment penetrations 180° (degrees) apart. Therefore, the safety-related portions of the main steam lines (each pair) cannot be affected by a single event. The portions of the main steam lines from the steam generators through the containment up through the first restraint beyond the outboard MSIVs, the MSIVs, the main steam safety valves, and the power-operated relief valves are located in seismic Category I, flood- and tornado-protected structures (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" X relating to damage to safety-related portions of the main steam lines by nonseismic Category I structures, systems or components as a result of an SSE. The lines are designed to Quality Group B and seismic Category I requirements up to and including the outboard MSIVs.

Downstream of the outboard restraints to the end of the tunnels the piping is ANSI B31.1 and designed to withstand the safe shutdown earthquake. Pipe whip restraints are provided as necessary. All branch lines upstream of the MSIVs up to and including the first normally closed valve or valve capable of automatic closure in the branch line are designed to seismic Category I, Quality group B standards, thus complying with the guidelines of Position C.1 and C.3 of Regulatory Guide 1.29, "Seismic Design Classification" relating to design of portions of main and branch steam lines and the extension of seismic Category I requirements. Thus, the safety-related portions 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 redundant electrohydraulic gate valves in each steam line located just outside the containment. Each MSIV is a bidirection (stops flow in either direction) wedge-type gate (two gate halves) valve. Upon receipt of a closing signal, the MSIVs complete the closing cycle despite the loss of normally required utility services (hydraulic fluid or power). Hydraulic fluid is used to hold the MSIV open and a self contained stored energy system provides the pressure for closing. A spherical nitrogen accumulator which is part of the valve actuator maintains a constant 2500 pound (gauge) pressure on the closing surface of the actuating piston. Hydraulic pressure at 4300 pounds is used to overcome this nitrogen pressure and hold the valve open. The actuator has sufficient self-contained capacity for two full closures withou restoration of nitrogen. The valves are designed to fail closed on loss of actuating power. The MSIVs automatically close on receipt of a steam line isolation signal (SLIS) which occurs on low steam line pressure in any line, high containment pressure, or high steam pressure rate in any loop. The MSIVs are designed to close in 5 seconds or less. Since there are redundant MSIVs in each line, blowdown of more than one steam generator is precluded without reliance on the turbine stop valves. Since redundant safety-grade MSIVs are provided for each generator, 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," are not applicable as reliance on the nonseismic Category I turbine stop valves and dump valves ~~are~~ is not ~~relied upon~~ required to mitigate the consequence of any pipe break.

Each steam generator (upstream of the MSIVs) is provided with a safety-grade seismic Category I, power operated atmospheric relief valve (Atmospheric Dump Valve) including the actuators, power supplies and controls. The valves are electrohydraulic ~~that~~ and use hydraulic pressure for opening and closing during valve modulation. An emergency nitrogren pressurized hydraulic reservoir is provided for emergency closure. The operation of these pressure relief valves is automatically controlled by steam line pressure during plant operations. They can be controlled from the control room or from the remote shutdown panels. The design complies with the requirements that safe shutdown be achieved with dependence upon safety-grade components only, assuming a single active failure with either onsite or offsite power, as specified in Position A.2, A.3, and A.4 of Branch Technical Position RSB 5-1, "Design Requirements of the Residual Heat Removal System." Twenty 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 105% of the design steam flow at an accumulation pressure not to exceed 110% of the design pressure. The five safety valves on each line are located outside of containment upstream of the MSIVs in accessible areas of the seismic Category I main steam valve areas. The MSIVs, safety valves, and power-operated atmospheric relief valves will undergo preoperational functional testing at normal design temperature and pressure. MSIV closure times and safety and 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" and the guidelines of Branch Technical Position RSB 5-1.

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 its safety function 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 satisfied.

Based on the above, we conclude that the main steam supply system from the steam generators through the main steam isolation valves up through the first restraints meets the requirements of General Design Criteria 2, 4, 5, and 34 with respect to protection against natural phenomena, missiles, sharing environmental effects and residual heat removal, and 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, protection against tornado missiles, ~~and high- and moderate-energy pipe breaks~~ and the guidelines of BTP RSB 5-1 related to safe shutdown from the control room using only safety-grade equipment. We, therefore, conclude that the main steam supply system is acceptable and meets the applicable 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 NUREG-0800 (SRP). 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 (Quality Group D, nonseismic Category I) circulating water system (CWS) provides cooling water to the main condensers. There are two 50-percent capacity (242,300 gpm) circulating water pumps per unit which are located in intake structure that is connected to a natural draft cooling tower basin via a canal. These pumps draw water from the tower basin and pump it through a common header (buried) to the main condenser located in the turbine building. The water from the main condenser flows through a common buried header back to the tower basin. Makeup to the tower basin is provided by four river makeup water pumps that supply makeup to both the Unit 1 & 2 basins.

[The applicant has examined the effects of flooding of safety-related equipment as a result of a circulating water system failure. As discussed in Section 3.4.1 of this SER, the flooding analyses only assumed a pipe crack since there are no expansion joints at the condenser connections. Since this is a nonseismic Category I system, we require the flooding analysis to be performed for a full guillotine break and reliance only on safety-grade seismic Category I equipment to mitigate the consequences of ~~an accident~~ the break. Until this analysis is done, we cannot make a determination with respect to the requirements of General Design Criterion 4, "Environmental and Missile Design Bases." We therefore cannot conclude the circulating water system is acceptable or meets the acceptance criteria of SRP Section 10.4.5]

10.4.7 Condensate and Feedwater System

The condensate and feedwater system was reviewed in accordance with Section 10.4.7 of NUREG-0800 (SRP). 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" section of the SRP. 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 and components from the condenser hotwell, 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 four steam generators. There are three fifty percent capacity condensate pumps and two feedwater pumps that are approximately 90 percent capacity each. The three condensate pumps are motor driven and the two feedwater pumps are turbine driven.

The system serves no safety function except for containment isolation and steam generator isolation. Therefore, the major portions of the system are not designed to seismic Category I requirements. Adequate seismic Category I isolation is provided at connections between seismic and nonseismic Category I piping. Nonseismic Category I portions of the system are also adequately separated from other seismic Category I systems. Therefore, failure of nonsafety-related (nonseismic) portions of the condensate and feedwater system will not affect safe plant shutdown.

The safety-related portions of the system are from the steam generator main feedwater nozzle, back through a check valve, a containment isolation valve, the containment isolation valves bypass which connects to the auxiliary feedwater (AFW) nozzle on the steam generator including a check valve and containment bypass isolation valve. These components and interconnecting piping are seismic Category I, Quality Group B, including the restraint at the isolation valves. As a backup to the containment isolation and bypass isolation valves, in the event of a main steam or feedwater line break inside containment, the main feedwater control valves and control bypass valves are also seismic Category I with safety-grade solenoids actuated from Class 1E signals. The piping between the containment isolation valves and control valves is designed to maintain its integrity in the event of a safe shutdown earthquake. These portions of the system are designed to seismic Category I~~, Quality Group B~~ requirements in order to assure feedwater isolation in accident situations and are located in seismic Category I, flood and tornado protected structures (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 are satisfied. The structure also provides protection against tornado missiles. The essential equipment is separated from the effects of internally generated missiles and is not adversely affected by 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 between units so that the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are satisfied.

Automatic isolation of the main feedwater system is provided when required to mitigate the consequences of a steam or feedwater line break. The electro-hydraulic fail closed main feedwater isolation valves and fail closed air operated bypass isolation valves close within 5 seconds on receipt of an engineered safety features (ESF) actuation signal. Redundant (back-up) safety grade feedwater line isolation is provided by the air operated fail-closed main feedwater control and bypass control valves which also close within 5 seconds on receipt of an ESF actuation signal. The safety related auxiliary feedwater system automatically provides flow to the steam generators via separate nozzles on each steam generator 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 condensate and feedwater system is designed with features to preclude the potential for damaging flow instabilities (waterhammer). The Vogtle units have a steam generator design (Westinghouse Model F) that has top discharge feedrings with J-tubes. The feedwater system piping is arranged to reduce the probability of draining the feedwater piping into the steam generator. Also the AFW system has its own inlet nozzle on the steam generator which is supplied by the main feedwater system during normal operation through the bypass line described above. INSERT Thus the guidance in Branch Technical Position ASB 10-2 "Design Guidelines for Water Hammers in Steam Generators with Top Feedring Designs," have been followed with regards to prevention of draining the main feed and auxiliary feedwater lines.

Based upon the above, we conclude that the safety-related portion of the condensate and feedwater system meets the requirements of General Design Criteria 2, 4, 5, 44, 45, and 46 with respect to its protection against natural phenomena, missiles and environmental effects, sharing, decay heat removal function, inservice inspection and testing, and meets the guidelines of Regulatory Guide 1.29 and Branch Technical Position ASB 10-2 with respect to its seismic classification and design and testing for prevention of damaging water hammer and is, therefore, acceptable. The condensate and feedwater system meets the acceptance criteria of SRP Section 10.4.7.

INSERT to Sect. 10.4.7, Page 10-7

The AFW piping to the nozzle is also arranged to reduce the probability of ~~waterhammer~~ draining. The AFW nozzle directs the AFW flow to a point below the tube wrapper where it is directed toward the center of the tubes by a flow distribution baffle at the bottom of the tube wrapper. During preoperational testing, unit operating procedures will be used when possible to conduct the tests and for verifying that the unit operating procedures do not result in waterhammer in the main or ~~AFW~~ auxiliary feedwater system.

10.4.9 Auxiliary Feedwater System

The auxiliary feedwater system was reviewed in accordance with Section 10.4.9 of NUREG-0800 (SRP). An audit review of each of the areas listed in the "Areas of Review" portion of the SRP sections 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 specific acceptance criteria of SRP 10.4.9 as follows:

(1) General Design Criterion 2 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 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 as related to the capability of shared systems and components important to safety to perform required safety functions.

(4) General Design Criterion 19 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 and 44 to ensure the capability to transfer heat loads from the reactor system to a heat sink under both normal operating and accident conditions; 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); and the capability to isolate components, subsystems, or piping if required so that the system safety function will be maintained.

(6) General Design Criterion 45 as related to design provisions made to permit periodic inservice inspection of system components and equipment.

(7) General Design Criterion 46 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.

The following evaluation discusses the implementation of these acceptance criteria and follows the order of SRP 10.4.9 (NUREG-0800). This evaluation also incorporates the staff review of the applicant's response to NUREG-0737 Item II.E.1.1. This includes:

(1) An evaluation against the deterministic criteria of the Standard Review Plan.

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

(3) The evaluation of system reliability based on the applicant's reliability study (presently being reviewed by our consultants).

(4) An evaluation of the design basis for the flow capability for the system.

The auxiliary feedwater (AFW) system is designed to supply high pressure feedwater 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 generator. It is an engineered safety features system which is relied upon to aid in preventing core damage in the event of transients such as loss of normal feedwater or a secondary system pipe rupture. The system consists of two 630 gallon per minute (gpm) motor-driven pumps and one 1300 gpm turbine-driven pump with associated valves, piping, controls, and instrumentation. The two motor-driven pumps are powered from two separate buses of emergency onsite electrical power and each normally discharges into two steam generators. The steam turbine-driven pump supplies water to all four steam generators. The supply line from each pump to each steam generator contains a check valve and a motor-operated control valve that also acts as an isolation valve. The steam for the turbine is supplied from two steam generators (1 and 2) upstream of the main steam isolation valves. The AFW flow to the steam generators is limited by a Flow orifice located in each AFW line just downstream of the AFW control valves. The orifices will restrict the flow to a depressurized steam generator and permit adequate flow to the intact steam generators following a main steam or feedwater line break inside containment. The turbine driven AFW pump train and controls are powered from a D-C source and completely independent of the motor-driven AFW pumps and controls.

Each unit has its own independent AFW system with no sharing of structures, systems, and components including the AFW water supply consisting of two condensate storage tanks (CSTs) per unit. Thus, the requirements of General Design Criterion 5, "Sharing of Structures, Systems and Components," are satisfied.

The AFWS is designed to seismic Category I, Quality Group C from the CSTs up to but not including the motor-operated control isolation valves. The motor-operated isolation/control valves and the piping and valves from the motor-operated valves to the steam generators are designed to seismic Category I, Quality Group B. Thus, the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1 are satisfied.

The AFWS is located within the AFW pumphouse, seismic Category I tunnels, auxiliary building, control building and containment and is thus protected against the effects of natural phenomena and tornado missiles (the CSTs are located outside of the buildings but are protected as discussed in Section 9.2.6

of this SER.) Thus, the AFWS meets the requirements of General Design Criteria 2, "Design Bases for Protection Against Natural Phenomena."

There are separate cubicles for each AFW pump in order to prevent possible internally generated missiles from damaging more than one pump. The applicant has provided the results of an analysis which shows that the missiles from the turbine-driven AFW pump cannot damage safety-related equipment from the other trains. Thus, the design is in conformance with General Design Criterion 4, "Environmental and Missile Design Bases" as it relates to protection against internally generated missiles (see Section 3.5.1.1 of this SER). The AFW system can be operated for approximately nine hours with the water reserved (330,000 gallons) in one CST. This amount is reserved in both CSTs. This includes four hours at hot standby condition and an additional five hour cool-down to 350°F and includes 30 minutes of flow from the turbine driven pump through a pipe break ~~and~~ plus the heat generated by one RCP. The additional safety grade CST provides a long term source of water in the event hot standby conditions have to be maintained for greater than four hours. The combined capacity can maintain hot standby for 31 hours followed by a 5 hour cooldown. Therefore, the AFW system complies with the guidelines of BTP RSB 5-1 and the requirements of General Design Criterion 19, with regard to cold shutdown from the control room using only safety-related equipment.

The AFWS has the capability to transfer decay heat loads from the secondary (steam) system under all conditions. The AFW system is required to supply a minimum of 510 gpm total flow to at least one steam generator and is capable of supplying at least that amount to at least two steam generators even with the occurrence of a single failure for the following and other transients:

1. loss of normal feedwater (510 gpm required)

2. loss of offsite power followed by reactor trip (470 gpm required)

3. secondary system pipe rupture (510 gpm required)

4. cooldown following steam generator tube rupture (470 gpm required)

5. loss-of-coolant accident, small break (470 gpm required)

Each motor-driven pump has a design flow of 630 gpm. A miniflow line for these pumps automatically isolates once flow has been established. The turbine-driven pump has design flow of 1300 gpm including a maximum recirculation flow limited by an orifice to 160 gpm. [The applicant has performed a reliability study of the AFWS in accordance with NUREG-0737, item II.E.1.1. This study is currently under review by our consultants, Brookhaven National Laboratory. Until this review is complete we cannot make a determination regarding General Design Criteria 34, "Decay Heat Removal," and 44, "Cooling Water"]

The AFW system has been designed to permit periodic testing. In addition, the applicant will perform periodic monthly tests in conformance with the Standard Technical Specifications for Westinghouse Pressurized Water Reactors, NUREG-0452. This meets the requirements of General Design Criterion 46, "Testing of Cooling Water System."

The AFW system has been designed to permit inservice inspection and periodic inspection of valves and pumps, thus meeting the requirements of General Design Criterion 45, "Inspection of Cooling Water System."

The AFW system has two diverse power sources which consist of offsite or onsite (Class 1E) AC power for the motor driven pumps and steam for the turbine driven pump. There are no auxiliaries in the train for the turbine-driven pump which require AC power to maintain operation of the train. This meets the guidelines of BTP ASB 10-1.

The AFW system is so designed that the turbine-driven pump portion of the system can be isolated from the portion containing the motor-driven pumps.

The AFW system is designed to supply water to the steam generators without throttling, thus avoiding throttling as a potential source of waterhammer. Waterhammer is also prevented by lines being full of water by the main feedwater system prior to AFW system initiation. Refer to Section 10.4.7 of this report for a further discussion of waterhammer.

We have evaluated the AFW system against the short and long term recommendations of NUREG-0611, "Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant Accidents in Westinghouse-Designed Operating Plants." The results of our review are discussed below:

GS-1 - Technical Specification Time Limits

The applicant has indicated that the outage time limit and the subsequent action time in the technical specifications will be as required by the standard technical specifications. This commitment is acceptable.

GS-2 - Administrative Controls on Manual Valves

This recommendation is not applicable to Vogtle, Units 1 & 2. Neither unit has any common suction piping between the primary water source (CST) and the AFW system. Separate piping from each CST is provided to each pump. There are no single valves or multiple valves in series which could interrupt all AFW flow if inadvertently left closed.

GS-3 - Throttling of AFW Flow

This is not applicable to Vogtle, Units 1 & 2. Operating procedures for the Vogtle units will not require valve throttling of the auxiliary feedwater flow during initial phases of automatc operation. It should be noted that orifices are provided downstream of the control valves, and the AFW is supplied to the steam generator through a separate nozzle, in lieu of using the main feedwater nozzle and feedring.

GS-4 - Emergency Procedure for Initiating Backup Water Supply

~~The applicant has stated that a procedure will be written for transferring to alternate source of AFW supply~~. Recommendation GS-4 included two cases which are to be covered by ~~this~~ a procedure for ~~[illegible]~~ transferring to an alternate water supply.

Case 1. Each pump has its own piping to each CST which is seismic Category I, flood and tornado missile protected. The normally lined up tank has two locked open isolation valves in series to each pump. The standby tank which is also protected against natural phenomena is normally isolated from the AFWS by a closed remote-manual valve in each line. Thus, this case is not applicable to the Vogtle units.

Case 2. Upon depletion of the tank in service, the standby tank can be placed in service from the control room or the remote shutdown panels. This case will be covered by normal shutdown/cooldown procedures.

The Vogtle design resolves the concerns of this recommendation.

GS-5 - Initiation of AFW Flow Following a Loss of AC Power

This is not applicable to Vogtle. Under loss of all ac power, the turbine driven feedwater pump, its associated flow path, and all instrumentation will initiate and maintain the auxiliary feedwater flow using only Class 1E dc power.

GS-6 - AFW Flow Path Verification

The AFW system is used for startup at Vogtle, therefore Case 2 does not apply. For Case 1, even while in test, the automatic start signal will align the system for operation, and the only valve that is placed in an off-normal position is the recirculation test line isolation valve, and if left open, a flow limiting orifice limits the flow to an acceptable value. Thus this recommendation is not applicable.

GS-7 - Nonsafety Grade, Nonredundant Automatic Initiation Signals

This is not applicable to Vogtle. The automatic start AFW signals and associated circuitry are safety grade. The details of the design are evaluated in Section 7 of this SER.

GS-8 - Automatic Initiation of AFW System

This is not applicable to Vogtle. The auxiliary feedwater system is automatically initiated.

Additional Short-Term Recommendations

No. 1 - Primary AFW Water Source Low Level Alarm

Redundant CST level indication with alarm is provided in the control room and at the remote shutdown panels. Each CST is sized with a volume adequate to maintain the plant at hot standby for 4 hours, followed by a 5 hour cooldown to 350°F prior to operation of the residual heat removal system. The low level alarm provides the operator with at least 20 minutes warning prior to switchover to the standby CST. This is acceptable.

No. 2 - AFW Pump Endurance Test

The applicant stated that the motor-driven auxiliary and turbine-driven feedwater pumps will be provided with a 48 hour endurance test. The turbine-driven auxiliary feedwater pump will be endurance tested using natural convection as the ventilation means. This commitment is acceptable.

No. 3 - Indication of AFW Flow to Steam Generators

Safety-grade flow transmitters, located upstream of the restrictive flow orifices, indicate flow to each of the steam generators. Refer to Section 7 of this SER for further evaluation.

No. 4 - System Availability During Periodic Surveillance Testing

This is not applicable to Vogtle. When either Class 1E auxiliary motor-driven pump is in the test mode, the other motor driven pump and turbine-driven pump is available for automatic operation. Also, the pump in test is available for automatic operation by overriding automatic controls that fully open the AFW control/isolation valve.

Long Term Recommendations

GL-1 Automatic Initiation of AFW Systems: The automatic start AFW signals and associated circuitry are safety grade. The details of the design are discussed in Section 7 of this SER.

GL-2 Single Valves in AFW Flow Path: Vogtle does not have common suction piping or any other single valve vulnerability. This recommendation is not applicable.

GL-3 Elimination of AC Power Dependency Following a Complete Loss of AC Power: This recommendation is satisfied since the turbine driven pump, its associated flow path, and all instrumentation will initiate AFW flow using only Class 1E dc power.

GL-4 Unprotected Normal Water Supply to AFW Pumps: This recommendation is not applicable since the normal water supply, the CSTs, are protected against all natural phenomena.

GL-5 Nonsafety Grade, Nonredundant Initiation Signals: This recommendation is not applicable since the automatic start signals and associated circuitry are safety grade. Refer to Section 7 of this SER.

Based on the above, we conclude that the AFWS complies with the requirements of General Design Criteria 2, 4, 5, 19, 45 and 46 with regard to protection against natural phenomena, missile protection, sharing, shutdown from the control room, and inspection and testing of the AFWS; the guidelines of Regulatory Guides 1.29, Position C.1 and C.2, and BTPs RSB 5-1 and 10-1 regarding seismic classification, shutdown from the control room with a single failure and AFWS power diversity; and the recommendations of NUREG-0611 concerning generic improvements to the AFWS design, procedures and specifications. [We have not completed our review of the applicant's AFWS reliability analysis and, therefore, have not made a determination with regards to General Design Criteria 34 and 44 as they relate to AFW system reliability. We, therefore, cannot conclude the acceptance criteria of SRP Section 10.4.9 are met.]