22. REGULATORY TREATMENT OF NON-SAFETY SYSTEMS

22.1 Introduction

Unlike the current generation of light-water reactors or the evolutionary advanced light-water reactors (ALWRs), the economic simplified boiling water reactor (ESBWR) plant design uses passive safety systems that rely almost exclusively on natural forces, such as density differences, gravity, and stored energy, to supply safety injection water and provide core and containment cooling. These passive systems do not include pumps; however, they do include some active valves. All the safety-related active valves require direct current (dc) safety-related electric power (supplied by batteries), are air operated (and fail safe on loss of air), or are check valves. The ESBWR design does not include any safety-related sources of alternating current (ac) power for the operation of passive system components. All active systems (i.e., systems requiring ac power to operate) are designated as non-safety-related, except for the instrumentation and control systems, which use safety-related ac power converted from safety-related dc power.

As the ESBWR relies on passive safety systems to perform the design-basis, safety-related functions of reactor coolant makeup and decay heat removal, different portions of the passive systems also provide certain defense-in-depth backup to the primary passive features. For example, while the passive isolation condenser system (ICS) is the primary safety-related heat removal feature in a non-loss-of-coolant transient, the automatic depressurization system (ADS), together with passive safety injection features, provides a safety-related, defense-in-depth backup.

The ALWR Utility Requirements Document (URD) for passive plants, (Electric Power Research Institute, 1992), issued by the Electric Power Research Institute (EPRI), includes standards related to the design and operation of active, non-safety-related systems. The URD recommends that the plant designer specifically define the active systems relied upon for defense in depth and necessary to meet passive ALWR plant safety and investment protection goals. Defense-in-depth systems provide long-term, postaccident plant capabilities. Passive systems should be able to perform their safety functions, independent of operator action or offsite support, for 72 hours after an initiating event. After 72 hours, non-safety or active systems may be required to replenish the passive systems or to perform core and containment heat removal duties directly. The ESBWR includes active systems that provide defense-in-depth (or investment protection) capabilities for reactor coolant system makeup and decay heat removal. These active systems are the first line of defense in reducing challenges to the passive systems in the event of transients or plant upsets. As noted above, most active systems in the ESBWR are designated as non-safety-related.

Examples of non-safety-related systems that provide defense-in-depth capabilities for the ESBWR design include the fuel and auxiliary pools cooling system (FAPCS), control rod drive (CRD) system injection function, reactor water cleanup/shutdown cooling system (RWCU/SDC), and the reactor component cooling water system. For these defense-in-depth systems to operate, the associated systems and structures to support these functions must also be operable, including non-safety-related standby diesel generators and the service water system. The ESBWR also includes other active systems, also designated as non-safety-related, such as the heating, ventilation, and air conditioning (HVAC) system, that remove heat from the instrumentation and control cabinet rooms and the main control room. These systems also prevent the excessive accumulation of radioactive materials in the control room in order to protect personnel in the control room.

In existing plants, as well as in the evolutionary ALWR designs, many of these active systems are designated as safety-related. However, by virtue of their designation in the ESBWR design as non-safety-related, the licensing design-basis transient analyses described in ESBWR Design Control Document (DCD) Tier 2, Revision 4, Chapter 15, do not model active systems (except in certain cases where operation of a non-safety-related system could make a transient worse). In SECY-90-406, “Quarterly Report on Emerging Technical Concerns,” dated December 17, 1990, the staff of the U.S. Nuclear Regulatory Commission (NRC) listed the role of these active systems in passive plant designs as an emerging technical issue. In SECY-93-087, “Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs,” dated April 2, 1993, the staff discussed the issue of the regulatory treatment of non-safety systems (RTNSS) and stated that it would propose a process for the resolution of this issue in a separate Commission paper. The staff subsequently issued SECY-94-084, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs,” dated March 28, 1994, which discusses that process. In SECY-95-132, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs,” May 22, 1995, the staff essentially revised SECY-94-084 to respond to Commission comments on that paper and to request Commission approval of certain revised positions. However, the staff’s position on RTNSS as discussed in SECY-94-084 was approved by the Commission in a staff requirements memorandum (SRM) dated June 30, 1994) and was unchanged in SECY-95-132.

In SECY-94-084, the staff cited the uncertainties inherent in the use of passive safety systems resulting from limited operational experience and the relatively low driving forces (e.g., density differences and gravity) in these systems. The uncertainties relate to both system performance characteristics (e.g., the possibility that check valves could stick under low differential pressure conditions) and thermal-hydraulic phenomena (e.g., critical flow through ADS valves). In some cases, design enhancements addressed the system performance issues. For example, designers improved check valve performance by using normally open check valves in the gravity-driven cooling system (GDCS) discharge lines. The applicant also addressed uncertainties associated with passive system reliability, as well as thermal-hydraulic uncertainties, by virtue of the test programs reviewed and approved by the NRC staff in the preapplication phase of the NRC review and as discussed in Chapter 21 of this report.

The residual uncertainties associated with passive safety system performance increase the importance of active systems in providing defense-in-depth functions to back up the passive systems. Recognizing this, the NRC and EPRI developed a process to identify important active systems and to maintain appropriate regulatory oversight of those systems. This process does not require that the active systems brought under regulatory oversight meet all safety-related criteria, but rather that these controls provide a high level of confidence that active systems having a risk-significant role are available when they are challenged.

The ALWR URD specifies standards concerning the design and performance of active systems and equipment that perform non-safety-related, defense-in-depth functions. These standards include radiation shielding to permit access after an accident, redundancy for the more probable single active failures, availability of non-safety-related electric power, and protection against more probable hazards. The standards also address realistic safety margin analysis and testing to demonstrate the systems’ capabilities to satisfy their non-safety-related, defense-in-depth functions. However, the ALWR URD does not include specific quantitative standards for the reliability of these systems.

SECY-94-084 and SECY-95-132 describe the scope, criteria, and process used to determine RTNSS for the passive plant designs. The staff has incorporated this information into Regulatory Guide (RG) 1.206, “Combined License Applications for Nuclear Power Plants,” dated June 2007.

The following five key elements make up the process:

(1) The ALWR URD describes the process to be used by the designer to specify the reliability/availability (R/A) missions of risk-significant structures, systems, and components (SSCs) needed to meet regulatory requirements and to allow comparisons of these missions to NRC safety goals. An R/A mission is the set of requirements related to the performance, reliability, and availability of an SSC function that adequately ensures the accomplishment of its task, as defined by the focused probabilistic risk assessment (PRA) or deterministic analysis.

(2) The designer applies the process to the design to establish R/A missions for the risk-significant SSCs.

(3) If active systems are determined to be risk significant, the NRC reviews the R/A missions to determine if they are adequate and whether the operational reliability assurance process or simple technical specifications (TSs) and limiting conditions for operation (LCOs) can provide reasonable assurance that the missions can be met during operation.

(4) If active systems are relied upon to meet the R/A missions, the designer imposes design requirements commensurate with the risk significance of those elements involved.

(5) A design certification rule will not explicitly state the R/A missions for risk-significant SSCs. Instead, the rule includes deterministic requirements for both safety-related and non-safety-related design features.

The following two sections discuss the steps of the RTNSS process to address the five key elements described above.

22.2 Scope and Criteria for the Regulatory Treatment of Non-Safety Systems Process

The RTNSS process applies broadly to those non-safety-related SSCs that perform risk-significant functions and therefore are candidates for regulatory oversight. The RTNSS process uses the following five criteria to determine those SSC functions:

(1) SSC functions relied upon to meet deterministic NRC performance requirements such as Title 10, Section 50.62, “Requirements for Reduction of Risk from Anticipated Transients without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants,” of the *Code of Federal Regulations* (10 CFR 50.62) for mitigating anticipated transients without scram (ATWS) and 10 CFR 50.63, “Loss of All Alternating Current Power,” for station blackout (SBO)

(2) SSC functions relied upon to ensure long-term safety (beyond 72 hours) and to address seismic events

(3) SSC functions relied upon under power-operating and shutdown conditions to meet the Commission's safety goal guidelines of a core damage frequency (CDF) of less than 1×10^{-4} per reactor year, and a large release frequency (LRF) of less than 1×10^{-6} per reactor year

(4) SSC functions needed to meet the containment performance goal, including containment bypass, during severe accidents

(5) SSC functions relied upon to prevent significant adverse systems interactions

Regarding criterion (4) above, the staff discussed this issue in detail in SECY-93-087. For the ESBWR, this criterion for assessing containment performance is the degree to which the design comports with the Commission's probabilistic containment performance goal of less than 0.1 conditional containment failure probability (CCFP) when no credit is provided for the performance of the non-safety-related, defense-in-depth systems for which there will be no regulatory oversight. The CCFP is a containment performance measure that provides perspectives on the degree to which the design has achieved a balance between core damage prevention and core damage mitigation. The staff used CCFP in a qualitative manner to confirm that the ESBWR design, combined with the regulatory oversight for identified SSCs, has maintained an acceptable balance between core damage prevention and mitigation. However, it did not use CCFP as a criterion for establishing the availability requirements for non-safety-related, defense-in-depth systems.

22.3 Specific Steps in the Regulatory Treatment of Non-Safety Systems Process

The staff established the specific steps described below for design certification applicants to implement the process given above. Section C.IV.9 of RG 1.206 incorporates these steps.

22.3.1 Comprehensive Baseline Probabilistic Risk Assessment

The RTNSS process starts with a comprehensive Level 3 baseline PRA, which includes all appropriate internal and external events for both power and shutdown operations. The process also includes adequate treatment of reliability and availability uncertainties, long-term safety operation, and containment performance. A margins approach is used to evaluate seismic events. In addressing containment performance, the PRA considers the sensitivities and uncertainties in accident progression, as well as the inclusion of severe accident phenomena, including the explicit treatment of containment bypass. The PRA uses mean values to determine the availability of passive systems and the frequencies of core damage and large releases. The process estimates the magnitude of potential variations in these parameters and identifies significant contributors to these variations using appropriate uncertainty and sensitivity analyses. Finally, the RTNSS process calls for an adverse systems interaction study to be performed and its results to be considered in the PRA. Chapter 19 of this report discusses the ESBWR baseline PRA, NEDO-33201, Revision 2, and "ESBWR Probabilistic Risk Assessment," dated September 2007.

22.3.2 Search for Adverse Systems Interactions

The RTNSS process includes the systematic evaluation of adverse interactions between the active and passive systems. The results of this analysis are used to initiate design improvements to minimize adverse systems interactions and are considered in developing PRA models, as noted above.

22.3.3 Focused Probabilistic Risk Assessment

The focused PRA is a sensitivity study that includes the passive systems and only those active systems necessary to meet the safety goal guidelines approved by the Commission in SECY-94-084 (see criterion 3 in Section 22.2 of this report). The focused PRA results are used in several ways to determine the R/A missions of non-safety-related, risk-significant SSCs.

First, the focused PRA maintains the same scope of initiating events and their frequencies as identified in the baseline PRA. As a result, non-safety-related SSCs used to prevent the occurrence of initiating events will be subject to regulatory oversight commensurate with their R/A missions.

Second, following an initiating event, the event tree logic of the comprehensive, Level 3 focused PRA will not include the effects of non-safety-related standby SSCs. This will allow the combined license (COL) applicant to determine if the passive safety systems, when challenged, can provide sufficient capability (without non-safety-related backup) to meet the NRC safety goal guidelines for a CDF of less than $1x10^{-4}$ per reactor year and an LRF of less than $1x10^{-6}$ per reactor year. The applicant will also evaluate the containment performance, including bypass, during a severe accident. If the applicant determines that non-safety-related SSCs must be added to the focused PRA model to meet the safety goals, these SSCs will be subject to regulatory oversight based on their risk significance.

22.3.4 Selection of Important Non-Safety-Related Systems

The RTNSS process includes the identification of any combination of non-safety-related SSCs that are necessary to meet NRC regulations, safety goal guidelines, and the containment performance goal objectives. These combinations are based on criteria (1) and (5) in Section 22.2 of this report, for which NRC regulations are the bases for consideration, and criteria (3) and (4) in Section 22.2 of this report, for which PRA methods are the bases for consideration. To address the long-term safety issue in criterion (2) of Section 22.2 of this report, the applicant will use PRA insights, sensitivity studies, and deterministic methods to establish the ability of the design to maintain core cooling and containment integrity beyond 72 hours. Non-safety-related SSCs that are required to meet deterministic regulatory requirements (criterion 1), resolve the long-term safety and seismic issues (criterion 2), and prevent significant adverse systems interactions (criterion 5) are subject to regulatory oversight.

The staff expects regulatory oversight for all non-safety-related SSCs needed to meet NRC requirements, safety goal guidelines, and containment performance goals, as identified in the focused PRA model. Using the focused PRA to determine the non-safety-related SSCs important to risk involves the following three steps:

(1) Determine those non-safety-related SSCs needed to maintain the initiating event frequencies at the comprehensive baseline PRA levels.

(2) Add the necessary success paths (an event sequence in the PRA event tree that results in no core damage) with non-safety-related systems and functions to the focused PRA to meet safety goal guidelines, containment performance goal objectives, and NRC regulations. Choose the systems by considering the factors for optimizing the design effects and benefits.

(3) Perform PRA importance studies to assist in determining the importance of these SSCs.

22.3.5 Non-safety-Related System Reliability/Availability Missions

Upon completion of the selection steps described in Section 22.3.4 of this report, the applicant should determine and document the functional reliability and availability missions of those active systems needed to meet safety goal guidelines, containment performance goals, and NRC performance requirements. The applicant should also propose regulatory oversights as discussed in Section 22.3.6 of this report. The applicant should repeat the steps described in Sections 22.3.4 and 22.3.6 of this report to ensure that it selects the most appropriate active systems and associated R/A missions.

As part of this process, the applicant should establish graded safety classifications and graded requirements for systems subject to RTNSS based on the importance to safety of their functional R/A missions.

22.3.6 Regulatory Oversight Evaluation

Upon completing the steps detailed in the previous five sections, the applicant should conduct the following activities to determine the means of appropriate regulatory oversight for the RTNSS-important systems:

- Review the information in ESBWR DCD Tier 2, Revision 4; the PRA; and plant performance calculations to determine whether the design of the risk-significant, non-safety-related SSCs satisfies the performance capabilities and R/A missions.

- Review the information in ESBWR DCD Tier 2, Revision 4, to determine whether it includes the proper design information for the reliability assurance program, including the design information necessary for compliance with 10 CFR 50.65, i.e., the Maintenance Rule.

- Review the information in ESBWR DCD Tier 2, Revision 4, to determine whether it includes proper short-term availability control (AC) mechanisms if required for safety as determined by risk significance.

22.4 <u>Other Issues Related to Regulatory Treatment of Non-safety Systems Resolution</u>

SECY-94-084 discussed several other issues related to overall passive plant performance or the performance of specific passive safety systems. The staff tied resolution of these issues to an acceptable resolution of the RTNSS issue. On the basis of the availability of short-term administrative controls for defense-in-depth equipment, as discussed in Section 22.5.9 of this report, the staff was able to reach acceptable conclusions regarding the ESBWR design related to (1) safe-shutdown requirements as discussed in Section 6.3.1.3 of this report, (2) SBO as discussed in Section 8.4.2 and 15.5.5 of this report, and (3) General Design Criterion (GDC) 17, “Electric Power Systems,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to

10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” which addresses ac offsite power sources as discussed in Chapter 8 of this report.

22.5 NRC Review of the Applicant’s Evaluation of Systems for Inclusion in the Regulatory Treatment of Non-safety Systems Process

ESBWR DCD Tier 2, Revision 4, Section 19A, describes the applicant’s implementation of the RTNSS process for the ESBWR. The applicant used this process to determine which non-safety-related systems in the ESBWR should be subject to regulatory treatment and under what conditions that treatment should apply. The implementation of the RTNSS process for the ESBWR followed the scope, criteria, and specific steps described in SECY-94-084 and SECY-95-132, which are discussed in Sections 22.2 and 22.3 of this report. The criteria used by the applicant to determine which systems required regulatory oversight were based on probabilistic risk assessments of passive system performance (focused PRA) and a study of initiating event frequency. In addition, the applicant evaluated containment performance challenges and seismic considerations, deterministic assessments of the design’s response to events such as ATWS and SBO, long-term safety (beyond 72 hours), and adverse systems interactions.

22.5.1 Focused Probabilistic Risk Assessment

As discussed above, one of the steps in the RTNSS process is the use of focused PRA results to identify non-safety systems needed to meet the CDF and LRF safety goal guidelines. Chapter 11 of the ESBWR PRA report (NEDO-33201) provides the detailed results of the focused PRA. Section 19.1.7 of this report summarizes the staff’s evaluation of the focused PRA results.

22.5.1.1 Summary of Technical Information

22.5.1.1.1 Probabilistic Risk Assessment Event Mitigation Evaluation

Chapter 11 of NEDO-33201 describes the focused PRA sensitivity studies performed by the applicant to quantify the importance of non-safety-related systems in mitigating events. The focused PRA sensitivity studies calculate the CDF and LRF without reliance on non-safety-related SSC mitigation. If a non-safety-related SSC mitigation function is relied upon in the focused PRA sensitivity studies in order for the calculated CDF and LRF to meet the safety goal guidelines, it is designated as risk important and will be subject to regulatory oversight. The focused PRA sensitivity studies include an evaluation of internal events and external events that occur at power and during shutdown operation.

The focused PRA sensitivity studies are based on the ESBWR baseline PRA by setting the failure probability of each non-safety SSC to one. The initiating event frequencies remain the same as in the baseline PRA. The Level 1 PRA model CDF is significantly impacted by the failure of the non-safety and RTNSS systems. Sections 11.3.3, 11.3.4, and 11.3.5 of the PRA list the non-safety systems considered in the focused PRA sensitivity studies. A series of additional studies were conducted to evaluate the impact of crediting individual non-safety systems. These sensitivities showed that the impact to CDF is significantly reduced with the availability of the diverse protection system (DPS). The unavailability of the DPS coupled with general transient initiator and common-cause failures of safety-related distributed control and information system (DCIS) software or reactor protection system (RPS) failures are dominant contributors to CDF.

The CDF and LRF goals will be met with the addition of portions of the DPS that provide the capability to manually actuate the emergency core cooling system (ECCS). The DPS functions are needed to counter the effects of a dominant risk contribution because of common-cause failures of actuation instrumentation and controls. The DPS has displays and manual control functions that are independent from those of the safety-related protection and safety-related system logic and control/engineered safety feature functions. They are not subject to the same common-mode failure as the safety-related protection system components. The manual controls include the manual initiation of the safety/relief valves, depressurization valves, GDCS, and standby liquid control (SLC) system valves, and the ICS.

Tables 11.3-20 through 11.3-39 of NEDO-33201 compare the results for the baseline, focused PRA, and RTNSS sensitivity studies. Table 19A-2 in ESBWR DCD Tier 2, Revision 4, lists the non-safety-related systems and functions credited in the RTNSS sensitivity study. The RTNSS sensitivity study credits safety systems and systems covered by RTNSS; however, the focused PRA sensitivity study credits only safety systems.

Since portions of the DPS are credited to meet the CDF and LRF safety goals, these functions are identified as RTNSS important and subject to regulatory oversight. In accordance with 10 CFR 50.36(c)(2)(ii)(D), criterion 4, LCOs must be established in the plant's TSs for an SSC that operating experience or PRA has shown to be significant to public health and safety. Therefore, as described in ESBWR DCD Tier 2, Revision 4, Section 16.0, the applicant has committed to enforcing the capability to manually actuate the ECCS and containment isolations through TSs.

22.5.1.1.2 Uncertainty Evaluation

Potential uncertainties associated with assumptions made in the PRA models of passive systems (e.g., failure rates of GDCS injection line check and squib valves) are evaluated in ESBWR DCD Tier 2, Revision 4, Section 19A.4.3. This PRA uncertainty evaluation determines which non-safety-related SSCs should be identified as RTNSS important to add margin to compensate for the PRA uncertainties. As a result of this evaluation, the following non-safety-related SSCs are designated as RTNSS important to add margin to compensate for potential uncertainties:

- The low-pressure core injection capability of the FAPCS was added to the ESBWR design, including support systems for that system. This function of the FAPCS is provided by two injection trains that are physically and electrically separated such that no single active component failure can fail the function.

- The basemat internal melt arrest and coolability (BiMAC) device was added to the ESBWR design. This device provides an engineered method to ensure heat transfer between a core debris bed and cooling water in the lower drywell during some severe accident scenarios. The BiMAC device was added to reduce the uncertainties involved with severe accident phenomena.

22.5.1.1.3 Probabilistic Risk Assessment Initiating Event Frequency Evaluation

ESBWR DCD Tier 2, Revision 4, Section 19A.4.4, describes the evaluation performed by the applicant to study the importance of the non-safety-related systems to the initiating event frequencies used for at-power and shutdown initiating event frequencies in the ESBWR PRA. Eight categories of initiating events were identified for at-power and shutdown conditions.

The at-power initiating event categories include the following:

- generic transients
- inadvertent opening of a relief valve
- transient with a loss of feedwater
- loss of preferred power
- loss–of-coolant accident (LOCA)

The shutdown initiating event categories include the following:

- shutdown loss of decay heat removal
- shutdown loss of offsite power
- shutdown LOCA

The evaluation of the importance of the unavailability of non-safety-related SSCs to the initiating event frequencies is based on the following three screening criteria:

(1) Are non-safety-related SSCs considered in the calculation of the initiating event frequency?

(2) Does the unavailability of the non-safety-related SSCs significantly affect the calculation of the initiating event frequency?

(3) Does the initiating event significantly affect the CDF and the LRF?

In ESBWR DCD Tier 2, Revision 4, Section 19A.4.4, the applicant stated that only safety-related systems are involved in the initiation of a stuck-open relief valve event and LOCA events inside containment. Therefore, in accordance with criterion 1 above, RTNSS for non-safety-related systems associated with these initiating events is not applicable.

In the case of generic transients, the initiating event frequency is an assumed bounding value based on operating experience and not dependent on the availability or reliability of any non-safety SSCs. Consequently, in accordance with criterion 2 above, no non-safety-related systems associated with these initiating events are candidates for regulatory treatment.

In ESBWR DCD Tier 2, Revision 4, Section 19A.4.4, the applicant stated that the loss of preferred power event category is a significant contributor to CDF and LRF for at-power and shutdown risk; however, the dominant risk contributions are from the loss of incoming ac power from the utility grid and weather-related faults. These faults are caused by the failure of components that are not controlled by the site organization. Non-safety-related SSCs controlled by the site organization, such as substations, breakers, motor control centers, and protective relays, do not significantly affect the initiating event frequency. In addition, the applicant noted that a non-safety-related emergency ac power system that is designed to mitigate the effects of a loss of preferred power will receive regulatory treatment under the RTNSS program.

The loss of feedwater event is caused by failures in non-safety-related components in the condensate and feedwater system and is a significant contributor to CDF. All three of the screening criteria are met, so the feedwater and condensate systems are RTNSS candidates. However, rather than proposing short-term ACs for these systems, the applicant considered improvement of various ESBWR design features that affect the operation of these systems to increase reliability so as to reduce initiating event frequency. The design improvements include several features in the advanced design of the new generation feedwater level control system, which adds significant reliability that leads to a lower probability of loss of feedwater initiating events. The feedwater level control system is implemented on a triplicate, fault-tolerant digital controller. The reliability of the feedwater control system (FWCS) controller will meet the requirement that the mean time to failure be greater than 1000 years. Therefore, a control failure is much less likely to occur in the ESBWR than in the design of the current generation of reactors. Because of these improvements in the feedwater controller design, the dominant contributors to a total loss of feedwater are a loss of control power to the feedwater controllers and loss of ac power to the pumps.

Initiating events considered for shutdown modes of operation (i.e., Modes 5 and 6) include LOCA, loss of preferred power, and loss of decay heat removal. The applicant concluded that the unavailability of non-safety-related systems did not affect the LOCA and loss of preferred power initiating events for reasons similar to those given for the at-power versions of these events. The non-safety-related RWCU/SDC removes decay heat in Modes 5 and 6, and therefore failures in this system may affect the loss of decay heat removal initiating event frequency. However, the applicant stated in Section 19A.4.4.7 that while operation of only one RWCU/SDC pump is required for decay heat removal during Modes 5 and 6, both pumps in the system are assumed to be running. Under this assumption, a single pump trip would not result in a loss of decay heat removal. Based on this assessment, the applicant concluded that no additional regulatory treatment was needed for the RWCU/SDC.

22.5.1.2 Regulatory Criteria

The NRC does not have any specific regulatory requirements governing the application of the focused PRA for determining non-safety systems requiring regulatory treatment. SECY-94-084, SECY-95-132, and the Commission’s SRM on SECY-94-083. These documents are referenced in NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (hereafter referred to as the Standard Review Plan), Section 19.0, which provides guidelines acceptable to the NRC for applying the focused PRA in the RTNSS process.

22.5.1.3 Staff Evaluation

22.5.1.3.1 Probabilistic Risk Assessment Event Mitigation Evaluation

The applicant has performed a focused PRA and applied it in a manner consistent with NRC guidance. Using this process, the applicant determined that NRC safety goals could not be met when the PRA credited only safety-related systems. It identified risk-significant functions of the non-safety-related DPS with mitigation capability sufficient to reduce the CDF and LRF below the NRC safety goals when credited in the PRA. The applicant has committed in ESBWR DCD Tier 2, Revision 4, Section 19A.8.4.5 to include requirements for the availability of these non-safety-related functions through TSs, in accordance with 10 CFR 50.36(c)(2)(ii)(D), criterion 4 as discussed in Section 22.5.8 of this report. In addition, because of the risk significance of these non-safety-related functions, they will be covered in the ESBWR design reliability assurance program (D-RAP) described in ESBWR DCD Tier 2, Revision 4, Section 17.4. The staff's evaluation of the applicants D-RAP and the SSCs that are included in the D-RAP is addressed in Section 17.4 of this report.

22.5.1.3.2 Uncertainty Evaluation

The applicant has identified the FAPCS and BiMAC device as non-safety-related SSCs requiring regulatory treatment to compensate for the uncertainty associated with assumptions made in the PRA models of passive systems. The FAPCS provides a diverse backup for the passive GDCS core injection function and therefore directly compensates for uncertainty in the treatment of passive systems. The debris bed cooling function of the BiMAC device provides defense-in-depth protection against containment failure and therefore compensates for uncertainty in the treatment of passive systems. For these reasons, the staff finds the applicant's treatment of uncertainty acceptable.

22.5.1.3.3 Probabilistic Risk Assessment Initiating Event Frequency Evaluation

The non-safety-related systems that impact the loss of feedwater initiating event are required to continuously operate to support normal plant power operation. By providing more fault-tolerant system designs that increase plant reliability and availability, these improvements directly increase plant safety by reducing the potential for plant transients or trips that could challenge the plant's normal operation. Because the regulatory oversight of the RTNSS-important non-safety-related SSCs is intended to ensure the reliability and availability of those systems that are normally in standby operation, it is not meaningful to consider additional regulatory oversight beyond the existing operational controls for the non-safety-related systems that are required to operate during power operation. The staff agrees with the applicant that additional regulatory oversight for the ESBWR non-safety-related SSCs that impact these two initiating events, beyond that provided by operational controls, will not provide significant benefit in reducing the initiating event frequency, the CDF, or the LRF. Therefore, the staff has determined that no additional oversight is needed.

The staff finds the applicant's assessment of LOCA and loss of preferred power initiating events for both at-power and shutdown conditions to be acceptable. The applicant's assessment of the shutdown decay heat removal initiating event is based on the assumption that both pumps in the RWCU/SDC will be running in Modes 5 and 6. The staff evaluation of this assumption is discussed in Section 19.1.6.1.2.2 (See discussion of RAI 19.1-4**).**

22.5.1.4 <u>Conclusions</u>

Based on the above evaluation, the staff has concluded that the applicant's process for using the focused PRA results to identify RTNSS-important non-safety-related SSCs follows the process approved by the NRC

22.5.2 Containment Performance Consideration

22.5.2.1 Summary of Technical Information

ESBWR DCD Tier 2, Revision 4, Section 19.2, assesses the ESBWR design for meeting the following deterministic containment performance goal described in SECY-93-087 and approved by the Commission in an SRM dated July 21, 1993:

> The containment should maintain its role as a reliable, leak-tight barrier by ensuring that containment stresses do not exceed ASME service level C limits for a minimum period of 24 hours following the onset of core damage, and that following this 24-hour period the containment should continue to provide a barrier against the uncontrolled release of fission products.

The applicant has not identified any non-safety-related SSCs that are relied upon to meet this performance goal. The applicant has also assessed compliance of the ESBWR design with the probabilistic containment performance goal of 0.1 CCFP with and without credit for non-safety-related SSCs. Chapter 11 of NEDO-33201 describes these studies, performed with the focused Level 2 PRA. The applicant asserted that the NRC goals of less than 1×10^{-4} per year for CDF and less than 1×10^{-6} per year for LRF can be met by crediting the DPS and portions of the alternate rod insertion (ARI) feature that support automatic DPS backup to reactor trip. No additional systems are required to meet the containment performance goal.

The applicant has addressed the potential for steam bypass of the suppression pool and potential failure of the passive containment cooling system (PCCS) heat exchanger tubes in the design of the ESBWR. It has not identified any non-safety-related SSCs that are relied upon to address these issues. ESBWR DCD Tier 2, Revision 4, Section 6.2.1.1.5, addresses steam bypass of the suppression pool. ESBWR DCD Tier 2, Revision 4, Section 6.2.2.3, discusses the design of the PCCS heat exchanger tubes.

22.5.2.2 Regulatory Criteria

The objective of the assessment is to identify any non-safety-related SSC functions needed to meet the containment performance goals, including that related to containment bypass during severe accidents. The containment bypass issue from SECY-93-087, Issue II.G, is concerned with potential sources of steam bypassing the suppression pool and failure of heat exchanger tubes in PCCCs.

For the ESBWR, the probabilistic criterion for assessing containment performance is the degree to which the design comports with the Commission's probabilistic containment performance goal of 0.1 CCFP when no credit is provided for the performance of the non-safety-related, defense-in-depth systems for which there will be no regulatory oversight. SECY-93-087 discusses the following deterministic criterion:

> The containment should maintain its role as a reliable, leak-tight barrier by ensuring that containment stresses do not exceed ASME service level C limits for a minimum period of 24 hours following the onset of core damage, and that following this 24-hour period the containment should continue to provide a barrier against the uncontrolled release of fission products.

22.5.2.3 Staff Evaluation

The staff's evaluation of the applicant's deterministic containment performance assessment appears in Section 19.2.4.3 of this report.

The staff's review of the applicant's Level 2 focused PRA appears in Section 19.1.7.4.3.3 of this report.

The staff's review of the PCCS heat exchanger tube design and those design features incorporated to address potential suppression pool bypass appears in Section 6.2 of this report.

The staff has identified open items in these sections and other chapters requiring resolution before it can conclude that no additional non-safety-related systems are needed to address concerns related to these design features.

22.5.2.4 Conclusions

The applicant has identified RTNSS-important SSCs that support the attainment of containment performance goals. The staff will make a final determination as to the completeness of the applicant's selection of SSCs in accordance with the containment performance criterion following resolution of open items discussed above. Because of the open items that remain to be resolved for this section, the staff was unable to finalize its conclusions regarding acceptability

22.5.3 Seismic Consideration

22.5.3.1 Summary of Technical Information

In ESBWR DCD, Revision 4, Section 19A.3.2, the applicant stated that the seismic margins analysis (SMA) described in Section 19.2.3.5 assesses the seismic ruggedness of safety-related plant systems and the non-safety systems required for long term safety (beyond 72 hours). Based on this analysis, the applicant indicated that no accident sequence has a high confidence of low probability of failure (HCLPF) ratio less than 1.67 times the peak ground acceleration magnitude of the safe-shutdown earthquake (SSE). Therefore, no additional non-safety-related SSCs are identified as RTNSS candidates because of seismic events.

In ESBWR DCD, Revision 4, Section 19A.1, the applicant discussed the criteria used to determine the systems that are candidates for consideration for regulatory oversight. The applicant stated that it divided systems meeting Criterion B, which are those SSCs relied upon to resolve long-term safety (beyond 72 hours) and to address seismic events, into the following two groups:

(1) Criterion B1 addresses those functions that provide defense-in-depth for key safety functions (core cooling, decay heat removal, and control room habitability) that are designed to seismic Category II standards so there is reasonable assurance that they can perform their functions following a seismic event.

(2) Criterion B2 addresses components that provide additional information for operators to diagnose plant conditions (postaccident monitoring (PAM)) and thus have a less direct effect on the success of key safety functions. Other augmented seismic design criteria provide reasonable assurance of the long-term functionality of monitoring components.

22.5.3.2 Regulatory Criteria

The staff policy associated with RTNSS, as delineated in SECY-94-084, states that SSC functions relied upon to resolve long-term safety (beyond 72 hours) and to address seismic events are candidates for consideration for regulatory oversight. SECY-94-084 also states that seismic events will be evaluated by a margins approach.

22.5.3.3 Staff Evaluation

The staff reviewed ESBWR DCD, Sections 19A.3.2 and 19.2.3.2.4, which refer to Section 15 of NEDO-33201 that describes the SMA. To gain a clear understanding of the details of the SMA in relation to the RTNSS components, in RAI 22.5-8 the staff asked the applicant to discuss the following:

- the basis for the assertion that RTNSS SSCs designed to the requirements of the 2003 International Building Code (IBC) will satisfy the minimum HCLPF value of 1.67 times the SSE

- the technical basis for applying generic fragility and capacity data in judging the seismic ruggedness of the systems that qualify for RTNSS

- the available ESBWR-specific component test-based or design-experience-based seismic capacity data that would further support the validity of the seismic capacity, fragility, and HCLPF values obtained in the SMA

In its response dated October 31, 2007, the applicant stated the following:

- The minimum HCLPF value has been revised to 0.84g (1.67*0.5g). As shown in ESBWR DCD Tier 2, Revision 4, Table 19.2-4, only safety-related SSCs and RTNSS Criterion B1 components, which are designed as seismic Category II, are included in the SMA and, therefore, are expected to be seismically rugged. The SMA does not credit any RTNSS Criterion B2 components, which are designed to the IBC provisions.

- Component fragilities have been revised and moved from Table 15-1 to Table 15-7 in ESBWR DCD Tier 2, Revision 4. The only RTNSS component included in the SMA is the diesel-driven pump for the fire protection system (FPS), which is designed to seismic Category I requirements in accordance with ESBWR DCD Tier 2, Revision 4, Section 19A.4.2.4, and its fragility is therefore achievable.

- The SMA approach is a qualitative process. However, safety-related equipment is also seismically qualified in a process that is test-based following the Institute of Electrical and Electronics Engineers (IEEE) Std 323, "Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations," issued September 2003, and IEEE Std 344, Revision 4, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," issued December 2004. The qualification process in these standards is a stable process for which high confidence is afforded the qualified equipment and the ability to meet the seismic margin is achievable in practice.

The staff noticed that in DCD Table 19.2-4 only safety-related SSCs in addition to the diesel-driven fire protection pump (RTNSS B1) were credited in the SMA. The applicant committed to design RTNSS B1 SSCs as seismic Category II, and in DCD Revision 4 Section 19A.4.2.4 the applicant stated that piping and components associated with the connection of the fire protection pump are designed to meet Quality Group C and seismic Category I. Accordingly, all SSCs included in the SMA are designed to withstand the SSE. Also the seismic qualification process in accordance with IEEE standards is acceptable to the staff and provides reasonable assurance that the qualified equipment will achieve the seismic margin. On this basis, RAI 22.5-8 is considered resolved.

22.5.3.4 Conclusions

The seismic margin analysis used to perform the seismic assessment of the ESBWR standard plant design does credit only safety-related SSCs and the diesel-driven fire protection pump. This pump is designed to seismic Category II requirements. All SSCs relied upon to address a design-basis seismic event are designed to withstand the effects of the SSE in accordance with the requirements of DCD Tier 2, Section 3.7, which provides reasonable assurance that these SSCs will achieve the seismic margin. On this basis, the results of the seismic margin assessment with regard to RTNSS components is acceptable to the staff.

22.5.4 Deterministic Anticipated Transient Without Scram and Station Blackout Evaluation

22.5.4.1 Station Blackout Assessment

22.5.4.1.1 Summary of Technical Information

The ESBWR is designed to cope with an SBO event for 72 hours. The analysis in ESBWR DCD Tier 2, Revision 4, Section 15.5.5, demonstrates that reactor water level is maintained above the top of active fuel by operation of the ICS, which is safety-related. Operation of the PCCS, which is also safety-related, maintains the containment and suppression pool pressures and temperatures within their design limits. Therefore, the integrity of containment is maintained. The ESBWR is designed to successfully mitigate an SBO event to meet the requirements of 10 CFR 50.63 without relying on non-safety-related systems.

22.5.4.1.2 Regulatory Criteria

The staff policy associated with RTNSS, as delineated in SECY-94-084, states that SSC functions relied upon to meet deterministic NRC performance requirements in 10 CFR 50.63 for mitigating SBO events are candidates for consideration for regulator oversight.

22.5.4.1.3 Staff Evaluation

Section 15.5.5 of this report presents the staff's safety evaluation of the applicant's analysis of the SBO event. Based on this review, the staff finds that the ESBWR can successfully mitigate an SBO event to meet the requirements of 10 CFR 50.63 without relying on non-safety-related systems.

22.5.4.2 Anticipated Transient Without Scram Assessment

22.5.4.2.1 Summary of Technical Information

Under 10 CFR 50.62, boiling-water reactors (BWRs) must have (1) an automatic recirculation pump trip, (2) an ARI system, and (3) an automatically initiated SLC system for ATWS prevention and mitigation.

The ESBWR does not use recirculation pumps as in the current BWR fleet, so the recirculation pump trip logic does not exist. Instead, the ESBWR uses natural circulation along with automatic feedwater control. Thus, the ESBWR has implemented an automatic feedwater runback (FWRB) feature under conditions indicative of an ATWS event. This provides a reduction in water level, core flow, and reactor power similar to the recirculation pump trip. This feature is judged to be a major contributor to preventing reactor vessel overpressure and possible short-term fuel damage for ATWS events.

The ESBWR has an ARI system with sensors and logic that are diverse and independent of the RPS. The ARI hydraulically scrams the plant using the three sets of air header dump valves of the CRD system. The ARI logic is implemented in the DPS.

The ESBWR has the required automatic initiation of the SLC system under conditions indicative of an ATWS. The ATWS/SLC system mitigation logic provides a diverse means of emergency shutdown using the SLC for soluble boron injection.

The ESBWR design uses electrical insertion of fine motion control rod drives with sensors and logic that are diverse and independent of the RPS.

A non-safety system may perform this ATWS diverse automated backup function if the system is of sufficient quality to perform the necessary function(s) under the associated event conditions, as described in the enclosure to Generic Letter 85-06, “Quality Assurance Guidance for ATWS Equipment That Is Not Safety-Related,” dated January 16, 1985. The ATWS mitigating logic system is implemented with the safety-related and non-safety-related DCIS. The non-safety-related DPS processes the non-safety-related portions of the ATWS mitigation logic and is designed to mitigate the effects of potential digital protection system common-cause failures. The DPS transmits the FWRB signal from the ATWS mitigation logic to the feedwater control system. The non-safety-related portions of the ATWS mitigation logic have been identified as requiring regulatory treatment in accordance with the RTNSS process.

22.5.4.2.2 Regulatory Criteria

The staff policy associated with RTNSS, as delineated in SECY-94-084, states that SSC functions relied upon to meet deterministic NRC performance requirements in 10 CFR 50.62 for mitigating ATWS are candidates for consideration for regulator oversight.

22.5.4.2.3 Staff Evaluation

The applicant selected the ARI system, the FWRB logic, and the ATWS initiation controls for the SLC system as RTNSS equipment. As discussed in DCD Tier 2, Revision 4, Sections 6.3.1 and 9.3.5, the SLC system is part of the ESBWR ECCS and is classified as safety-related. It is only the ATWS/SLC actuation logic that is classified as a RTNSS function. The applicant stated in ESBWR DCD, Revision 4, Section 19A.2.1, that the requirements for these systems and functions are consistent with those specified in the ATWS rule. Chapter 7 of this report presents the detailed safety evaluation of the specific physical equipment; logic; detailed design; design acceptance criteria; defense-in-depth attributes; self-testing features; and inspections, tests, analyses, and acceptance criteria used to satisfy the ATWS rule. Section 15.5.4 of this report presents the staff's safety evaluation of the applicant's analysis of the ATWS event.

22.5.4.2.4 Conclusions

Based on its review, the staff concludes that the applicant has correctly identified the non-safety equipment relied upon to meet the ATWS rule and therefore requiring regulatory treatment.

22.5.5 Evaluation of Adverse Systems Interactions

22.5.5.1 Summary of Technical Information

ESBWR DCD Tier 2, Revision 4, Section 19A.6, states that the purpose of the Criterion E analysis is to systematically evaluate adverse interactions between the active and passive systems. Section 19A.6 states that an adverse systems interaction exists if the action or condition of an active, interfacing system causes a loss of safety function of a passive safety-related system. The section states that a systematic process is used to analyze specific features and actions that are designed to prevent postulated adverse interactions, while taking into consideration the operating experience that has been used in the current design criteria to prevent adverse systems interactions.

22.5.5.2 Regulatory Criteria

The NRC staff presented criteria for the evaluation of non-safety-related SSCs in SECY-94-084. The SECY paper indicates that the functions of SSCs relied upon to prevent significant adverse systems interactions are candidates for consideration of regulatory oversight. The staff used the guidance in the SECY paper and associated SRM (dated June 30, 1994) as the basis for the review of the applicant's approach to the evaluation of adverse systems interactions in the ESBWR.

22.5.5.3 Staff Evaluation

The NRC staff reviewed the description of the evaluation of adverse systems interactions provided in ESBWR DCD Tier 2, Revision 4. In RAI 22.5-14, the NRC staff asked the applicant to identify those components of active systems that, if they were to fail, could cause a loss of safety function of a passive safety-related system. For those components for which failure could lead to a loss of safety function of a passive safety-related system, the staff requested that the applicant evaluate whether regulatory oversight is needed and determine the appropriate level of regulatory oversight commensurate with their risk importance. The applicant referred to its response to RAI 22.5-17 for this request**. RAI 22.5-14 is now closed and the staff is tracking this issue under RAI 22.5-17.**

In RAI 22.5-17, the staff requested that the applicant provide additional detail to explain and clarify the systematic approach used to evaluate adverse system interactions, including the manner in which potential adverse system interactions are evaluated for non-safety-related components. In its response to RAI 22.5-17, the applicant described the systematic approach. Passive safety functions are evaluated to identify target areas or components that could be affected by an adverse condition. The systems that interface with each passive safety function are identified to determine if there are non-safety-related SSCs that could potentially cause a failure of a passive safety function. Each interface between a non-safety-related SSC and a passive safety function is evaluated for potential adverse effects. Both functional and spatial interactions are addressed. Spatial interactions are further addressed in the development of the fire and flooding portions of the PRA model. The result of the systematic evaluation is the identification of non-safety-related SSCs that could cause adverse system interactions, and these SSCs would be considered for additional regulatory oversight.

In response to RAI 22.5-17, the applicant stated that the result of the evaluation of the ESBWR did not identify any SSCs that should be considered for its RTNSS program. In Supplement 1 to RAI 22.5-17, the staff requested that the applicant explain how potential adverse system interactions for non-safety-related components from functional or spatial interactions will be identified and addressed during detailed engineering and construction phase to ensure that the functions of safety related and RTNSS systems will not be adversely impacted. The staff also requested that GEH consider adding a COL action item to address this issue. The staff is reviewing GEH's response to RAI 22.5-17 S01. **RAI 22.5-17 is being tracked as an open item.**

22.5.5.4 Conclusions

Because of the open item that remains to be resolved for this section, the staff was unable to finalize its conclusions regarding acceptability.

22.5.6 Post-72-Hour Actions and Equipment

22.5.6.1 Summary of Technical Information

The ESBWR is designed so that passive systems are able to perform all safety functions for 72 hours after an initiating event without the need for active systems or operator actions. After 72 hours, non-safety-related systems can be used to replenish the passive systems or to perform safety and postaccident recovery functions directly. In ESBWR DCD Tier 2, Revision 4, Section 19.A.3.1, the applicant described the actions and equipment needed in the post-72-hour period for the ESBWR. This section of the DCD states that the following safety functions are relied upon in the period following 72 hours after an accident:

- decay heat removal
- core cooling
- control room habitability
- PAM

Section 19.A.3.1 describes the non-safety-related equipment that is relied upon to ensure that these safety functions are successful in the post-72-hour period. The staff's regulatory criteria and evaluation of this information against those criteria are provided below.

22.5.6.2 Regulatory Criteria

The staff evaluation of post-72-hour actions appears in SECY-96-128, "Policy and Key Technical Issues Pertaining to the Westinghouse AP600 Standardized Passive Reactor Design," dated June 12, 1996, which the Commission approved in a memorandum dated January 15, 1997. In this document, the staff took the position that post-72-hour actions related to all design-basis events must be accomplished with onsite equipment and supplies for the long term. After 7 days, replenishment of consumables, such as diesel fuel oil from offsite suppliers, can be credited. The staff further stated that the equipment needed for post-72-hour support need not be in "automatic standby mode," but must be readily available for connection and protected from natural phenomena, including seismic events, as required by GDC 2, "Design Bases for Protection Against Natural Phenomena". In a memorandum to the Commission dated June 23, 1997, the staff outlined the implementation of the staff position in SECY-96-128. The staff stated that in order to ensure that post-72-hour SSCs can withstand the effects of an SSE without the loss of capability to perform their required functions, the SSCs should be analyzed, designed, and constructed using the method and criteria for seismic Category II building structures. The staff also stated that a COL applicant would be required to have appropriate ACs, consistent with RTNSS requirements, for non-safety-related SSCs for post-72-hour support.

22.5.6.3 Staff Evaluation

22.5.6.3.1 Augmented Design Standards

In ESBWR DCD Tier 2, Revision 4, Section 19A.3.1, the applicant stated that SSCs required to perform safety functions after 72 hours are designed to appropriate seismic design standards. In addition, SSC design must consider high-wind criteria, and the SSCs must be protected from flood. They must also survive accident environmental conditions.

In ESBWR DCD Tier 2, Revision 4, Section 19A.8.3, the applicant described the augmented design standards used in the design of RTNSS systems that meet Criterion B. The applicant reiterated that Criterion B1 SSCs are designed in accordance with seismic Category II requirements. Criterion B2 SSCs are designed for seismic requirements consistent with the IBC. The building structures are classified as Category IV with an occupancy importance factor of 1.5. The applicant also stated that all Criterion B systems must meet design standards to withstand winds and missiles generated from Category 5 hurricanes. With regard to flood protection, the applicant stated that the plant design considers the relevant requirements of GDC 2, and it meets the guidelines of RG 1.59, Revision 1, "Design Basis Floods for Nuclear Power Plants," issued August 1977, with regard to the determination of flood design criteria and RG 1.102, Revision 1, "Flood Protection for Nuclear Power Plants," issued September 1976, with regard to the means for protection of safety-related SSCs against flood.

The staff reviewed the augmented design standards described in ESBWR DCD Tier 2, Revision 4, Section 19A.8.3. The staff finds that the design of RTNSS SSCs meeting Criterion B1 in accordance with seismic Category II requirements provides reasonable assurance that these SSCs can perform their function following a seismic event and, therefore, is acceptable.

With regard to IBC seismic provisions proposed by the applicant for the design of RTNSS SSCs meeting Criterion B2, the staff noticed that these seismic provisions use a 2500-year event as the maximum considered earthquake. This ground motion is then reduced by a factor of two-thirds to produce the design ground motion. Such ground motion may have a return period varying from approximately 500 to 1500 years, depending on the regional seismicity. The design seismic demands are further modified (generally reduced) in the design calculations to account for earthquake energy absorption through nonlinear behavior (i.e., component cracking and yielding). Structures classified as IBC Occupancy Category IV are designed as Seismic Use Group III and are expected to achieve the immediate occupancy performance level at the design-level ground motion. Based on the provisions documented in Federal Emergency Management Agency (FEMA) 450, "2003 NEHRP Recommended Provisions for Seismic Regulations of New Buildings and Other Structures," issued June 2004, which forms the technical bases for the IBC seismic provisions, “immediate occupancy” is a performance level below an operational or a functional level. FEMA 450 further states that at the immediate occupancy level, damage to the structural systems is very slight and the structure remains safe to occupy; however, some repair is probably required before the structure can be restored to normal service. Equipment housed in such structures, on the other hand, is expected to experience more damage. In particular, utilities necessary for the normal function of systems are not expected to be available. In addition, some equipment and systems may experience internal damage because of the shaking of the structure. Ultimately, minor structural repairs are required; however, significant nonstructural repair and cleanup are probably required before normal function of the structure can be restored.

Based on the staff’s understanding of the limitations of the IBC seismic provisions, the staff asked the applicant to clarify its approach for achieving functional performance under SSE conditions for all Criterion B RTNSS SSCs. In RAI 22.5-6, the staff asked the applicant to confirm that the ESBWR design does not contain non-safety-related structures, which either support or surround the RTNSS systems, whose failure may negatively affect the RTNSS system functions.

In its response dated August 2, 2007, the applicant stated that the structures that house the systems and components that meet RTNSS Criteria B1 and B2 are required to meet the augmented standards presented in ESBWR DCD Tier 2, Revision 4, Section 19A.8.3. The applicant also provided a table showing the structures that house RTNSS components for criteria other than B and indicated that the minimum structural design classification for those structures is seismic Category II.

The staff requested the following additional information in supplemental RAI 22.5-6 S01 to obtain an explanation of the applicant’s approach to compensate for the limitations of the IBC provisions:

(1) Identify in the DCD all non-safety-related, nonseismic structures that house/support RTNSS systems meeting Criteria B1 and B2.

(2) Provide the technical rationale to support the applicant’s assertion that IBC seismic provisions will achieve functional performance under SSE conditions.

(3) Given the lower hazard and performance levels of the IBC as compared to the SSE hazard with a functional performance level, explain how the applicant will ensure the availability and reliability of RTNSS Criterion B2 systems and their surrounding/supporting structures.

(4) In the event of an SSE, explain in the DCD how RTNSS Criteria B1 and B2 systems are protected against adverse interaction resulting from the failure of adjacent non-safety-related, nonseismic structural and nonstructural components that are designed to the IBC seismic provisions.

RAI 22.5-6 is being tracked as an open item.

In addition, in RAI 22.5-7, the staff asked the applicant to discuss its specific application of the provisions of the IBC for the design of both equipment and structures meeting RTNSS Criterion B.

In its response dated November 15, 2007, the applicant reiterated that Criterion B1 systems are designed to seismic Category II requirements, while the IBC is applied to the design of Criterion B2 systems as follows:

The maximum earthquake ground motion response spectrum is the single-envelope ESBWR SSE design response spectrum shown in ESBWR DCD Tier 2, Revision 4, Figure 2.0-1, for seismic Category I and II SSCs.

(1) The RTNSS design ground motion spectrum is two-thirds SSE.

(2) Structures, piping or components, according to IBC Section 1616.3, shall be designed as Seismic Design Category D under Seismic Use Group III with an Importance Factor of 1.5.

(3) Equipment seismic loads shall be calculated in accordance with American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI) 7-02, "Minimum Design Loads for Buildings and Other Structures," issued 2002, Equations 9.6.1.3-1, 9.6.1.3-2, 9.6.1.3-3, and 9.5.2.7 for horizontal, maximum, minimum, and vertical loads, respectively.

The applicant also stated that the electrical building is a RTNSS structure, it houses two non-safety-related standby diesel generators, and it provides space to the Technical Support Center. The electrical building is non-safety-related, nonseismic, and is designed to the Criterion B2 augmented design as described above.

Based on the staff's understanding of the IBC, the augmented seismic design criteria, as delineated in the applicant's response, will allow Criterion B2 RTNSS SSCs to achieve the immediate occupancy performance level at two-thirds SSE. In accordance with FEMA 450, this is a state of some level of damage (lower for the structure and higher for the equipment) at two-thirds SSE. This is not sufficient to provide reasonable assurance that Criterion B2 SSCs will function after an SSE event. In supplemental RAI 22.5-7 S01, the staff requested the applicant to:

(1) Provide a detailed explanation for the applicant's assertion that an immediate occupancy performance level at two-thirds SSE will provide reasonable assurance that Criterion B2 SSCs will function after an SSE event.

(2) If applicable, provide in the DCD the applicant's specific modifications to the IBC provisions in order to improve the performance criteria for RTNSS Criterion B2 SSCs to a functional performance level at an SSE event.

RAI 22.5-7 S01 is being tracked as an open item.

In ESBWR DCD Tier 2, Revision 4, Section 19A.8.1, the applicant stated that regulatory oversight for RTNSS systems is categorized as high regulatory oversight (HRO), low regulatory oversight (LRO), or support. In Section 19A.8.3, the applicant also stated that the augmented design standards are applied to HRO and LRO systems that meet Criterion B. Since many of the RTNSS Criterion B systems were designated as regulatory oversight "support" in ESBWR DCD Tier 2, Revision 4, Table 19A-2, in RAI 22.5-21, the staff asked the applicant to identify the standards used for the design of the RTNSS systems designated as "support." **RAI 22.5-21 is being tracked as an open item.**

In ESBWR DCD Tier 2, Revision 4, Section 19A.8.3, with respect to wind design for RTNSS components, the staff noticed that the applicant committed to design Criterion B systems to withstand winds and missiles generated from Category 5 hurricanes. However, the applicant did not provide wind design parameters and missile characteristics. In addition, the applicant stated that the plant design for safety-related SSCs satisfies GDC 2 and meets the requirements of RG 1.59 and RG 1.102 in relation to developing flood design criteria and protection against flood. However, the applicant did not note that these design criteria and RGs are used in the flood design/protection of RTNSS systems. In RAI 22.5-9, the staff asked the applicant to provide a discussion including key examples for demonstrating how the stated deterministic evaluation requirements are implemented for the RTNSS systems. **RAI 22.5-9 is being tracked as an open item.**

In RAI 22.5-5, the staff asked the applicant to describe how RTNSS systems will be protected specifically from:

1. flood-related effects associated with both high and moderate-energy fluid piping and component failures inside and outside containment;

2. flood-related effects associated with both natural phenomena and system and component failures;

3. postulated piping failures in fluid systems outside containment.

4. missiles.

RAI 22.5-5 is being tracked as an open item.

The staff finds that the design of RTNSS SSCs meeting Criterion B1 in accordance with seismic Category II standards provides reasonable assurance that these SSCs can perform their function following a seismic event and, therefore, is acceptable. Because of the open items that remain to be resolved for this section, the staff was unable to finalize its conclusions regarding acceptability of the design of RTNSS SSCs meeting Criterion B2.

22.5.6.3.2 Decay Heat Removal

The decay heat removal safety function is to remove reactor decay heat from the core, containment, and spent fuel pool. The passive systems that provide this function for the core and containment are the safety-related ICS and the safety-related PCCS). These systems are capable of removing decay heat for at least 72 hours without the need for active systems or operator actions. Section 19.1.6.1 of this report discusses the performance of the ICS to perform the decay heat removal function in MODE 5 (see RAI 19.1-144)**.** After 72 hours, makeup water is needed to replenish the boiloff from the upper containment and spent fuel pools. The FPS provides makeup to the pools via piping in the FAPCS. In ESBWR DCD Tier 2, Revision 4, Section 19A.3.1.2, the applicant identified the following equipment relied upon to accomplish this makeup function:

- diesel-driven FPS pump
- piping in the FPS
- piping in the FAPCS

The applicant stated in ESBWR DCD Tier 2, Revision 4, Section 9.5.1.1, that the diesel-driven pump and piping in the FPS meet the augmented design requirements listed in ESBWR DCD Tier 2, Revision 4, Section 19.A.8.3. This equipment will be designed in accordance with the seismic Category I standard, which is acceptable. However, the extent to which this component will be protected from natural phenomena remains a question. The staff raised this question in RAI 22.5-21. **RAI 22.5-21 is being tracked as an open item.**

In ESBWR DCD Tier 2, Revision 4, Section 9.5.1.4, the applicant stated that the fuel oil tank for the primary diesel-driven fire pump has a capacity of 1000 gallons, and, with such a capacity, the diesel-driven fire pump can provide makeup water to the ICS/PCCS pools from 72 hours to 7 days after an accident. To determine the capacity, the applicant has assumed that the diesel-driven pump need not operate continuously to supply the required quantity of makeup water to the pools. This is because the flowrate required for performing this function is less than the flowrate required for supplying firewater. Consequently, the fuel capacity required before tank refilling is based on fuel consumption for injecting the required makeup quantity rather than operation of the diesel engine for approximately 96 hours. The staff finds this approach acceptable.

The water for makeup is stored in the FPS primary storage tanks, which are designed to the seismic Category 1 standard and, together, hold over 1 million gallons of water. In ESBWR DCD Tier 2, Revision 4, Section 9.5.1.4, the applicant stated that these tanks have sufficient capacity to meet total demand in the post-72-hour period up to seven (7) days following an accident. After seven (7) days, onsite or offsite makeup sources can be used. Given the expected decay heat level for the ESBWR in the four-day post-72-hour period, more than enough water will be available in the storage tanks to make up for boiloff in the upper containment pools.

The Availability Controls Manual (ACM), documented in ESBWR DCD Tier 2, Revision 4, Section 19ACM, and discussed in Section 22.5.9 of this report, provides the short-term ACs for the equipment listed herein.

The equipment identified by the applicant is sufficient to perform the makeup function in the post-72-hour period for up to seven (7) days and satisfies the majority of the regulatory criteria listed above in Section 22.5.6.2, with exceptions noted as open items.

22.5.6.3.3 Core Cooling

The core cooling safety function is to provide an adequate inventory of water to ensure that the fuel remains cooled and covered, with stable and improving conditions, beyond 72 hours. This function is met by the safety-related ICS for scenarios with the reactor coolant system intact, and by the safety-related GDCS injection function for scenarios with the reactor coolant system open to containment. As long as decay heat removal is ensured in the post-72-hour period (i.e., makeup water is provided to the upper containment pools as needed), the GDCS provides a sustainable closed-loop method to keep the core covered. Consequently, the applicant has concluded that neither non-safety-related equipment nor operator actions are directly relied upon to support the core cooling safety function, and there are no RTNSS requirements to support post-72-hour core cooling.

Based on its review of the ICS and GDCS designs documented in Sections 5.4.6 and 6.3 of this report, respectively, the staff agrees that these systems can perform the post-72-hour core cooling function as long as makeup water is provided as described in Section 22.5.6.3.2. The applicant's proposed treatment of the core cooling safety function is therefore acceptable.

22.5.6.3.4 Control Room Habitability

Safety-related portions of the control room habitability area ventilation system maintain control room habitability. This function is operated on safety-related battery power for the first 72 hours following an event. A small portable dedicated electrical generator provides backup power (post-72 hours) to the safety-related control room emergency filtration unit (EFU) fans. This generator is required to support operation of the control room EFU beyond 72 hours through 7 days after an accident. This ac power generator is kept on the plant site to power the EFU fan system. For a period between seven days out to 30 days, the EFU can be powered from either offsite power or onsite diesel generators, or by continued use of the small ac power generator. For this reason, the applicant has identified this portable ac power generator as a non-safety component requiring regulatory treatment under the RTNSS process. The staff finds this acceptable because the portable generator satisfies the criterion that equipment needed for post-72-hour support need not be in "automatic standby mode," but must be readily available for connection. The applicant has identified this component as one meeting Criterion B1 augmented design requirements. As such, and as discussed above in Section 22.5.6.3.1, the seismic design of this component is acceptable. However, the extent to which this SSC will be protected from natural phenomena remains a question. The staff identified this question in RAIs 22.5-9 and 22.5-21. **RAIs 22.5-9 and 22.5-21 are being tracked as open items.**

22.5.6.3.5 Postaccident Monitoring

In ESBWR DCD, Tier 2, Revision 4, Section 19A.3.1.4, the applicant stated that operator actions are not required for the successful operation of safety-related systems for the first 72 hours following an event. Beyond that, operator actions are necessary to support continued operation of decay heat removal and control room ventilation systems. These functions can be performed without any support systems or indications (other than local indications on the equipment to be operated) under normal circumstances. However, the operators can use information on the condition of the plant to determine ways to augment the functions needed for beyond-design-basis response. This provides an additional flexibility (defense-in-depth) for the operators to respond in the post-72-hour timeframe.

The DCIS provides the required signal paths to process PAM information. The DCIS is subdivided into the safety-related Q-DCIS and the non-safety-related N-DCIS. For accident monitoring instrumentation associated with critical safety functions and powered from the safety-related sources, the Q-DCIS provides the required signal path. This information then appears on Q-DCIS divisional safety-related displays. Safety-related sources power Type A, Type B, and Type C variables.

The safety-related information also can be transmitted via isolated safety-related gateways to the N-DCIS for input to non-safety-related displays, plant computer functions, and the alarm management system. For Type D and Type E variables that are powered from non-safety-related sources, the N-DCIS provides the required signal paths to process the information. Plant computer functions provide non-safety-related navigational or top-level displays for safety parameter displays, alarms and enunciators, and the bypass and inoperable status indicator. The N-DCIS also provides data support functions (e.g., Technical Support Center, emergency operations facility, and Emergency Response Data System). Most PAM is expected to be performed using the Q-DCIS system, so there would be no direct components covered by

RTNSS. Non-safety-related support systems needed to provide power to the Q-DCIS following depletion of the safety-related batteries are addressed below in this section of the report. TSs direct and control operability and surveillance testing of the Q-DCIS.

The non-safety-related PAM instrumentation function supports post-72-hour recovery operations; for this reason, the applicant has identified it as a non-safety-related function that requires regulatory treatment. The staff concurs that the applicant has correctly identified the PAM instrumentation function as a non-safety system relied upon and requiring RTNSS designation. Chapter 7 of this report covers verification of the acceptability of the actual PAM variable list and specific instrumentation.

In ESBWR DCD Tier 2, Revision 4, Table 19A-2, the applicant identified the PAM instruments and many of the HVAC and electric power-related SSCs that support operation of the PAM instruments as meeting RTNSS Criterion B2 augmented design requirements. As such, and as discussed above in Section 22.5.6.3.1, questions regarding the acceptability of the associated seismic design requirements was raised in RAI 22.5-7 Supplement 1. **RAI 22.5-7 is being tracked as an open item.** In addition, as discussed above, questions regarding the extent to which these SSCs will be protected from natural phenomena was raised in RAIs 22.5-9 and 22.5-21. **RAIs 22.5-9 and 22.5-21 are being tracked as open items.**

22.5.6.4 <u>Conclusions</u>

Because of the open items that remain to be resolved for this section, the staff was unable to finalize its conclusions regarding acceptability.

22.5.7 Mission Statements and Regulatory Oversight of Important Non-safety-Related Structures, Systems, and Components

22.5.7.1 <u>Summary of Technical Information</u>

In accordance with the RTNSS process, non-safety-related SSCs relied upon to meet the criteria described in Section 22.2 of this report are designated as RTNSS important and are subject to regulatory oversight. As described in Sections 22.5.1 through 22.5.6 of this report, the applicant has identified the RTNSS-important SSCs. In ESBWR DCD Tier 2, Revision 4, Section 19A.8.4, the applicant identified these important non-safety systems, their missions, and recommended regulatory oversight. Table 22-1 lists the included SSCs.

Table 22-1 RTNSS-Important SSCs

SSC	Mission(s)	RTNSS Criterion (as defined in Section 22.2)
ARI	Automatically depressurize scram header on ATWS signal	(1)
BiMAC	Provide core debris cooling in LDW through deluge valves	(3)
Control Building HVAC	Provide post-72-hour cooling for DCIS and control room habitability	(2)
Chilled Water System	Provide post-72-hour cooling for HVAC; provide cooling support for FAPCS	(2)
Control Room Area Ventilation	Portable generator for post-72-hour ventilation	(2)
Diesel Fire Pump	Provide post-72-hour refill to PC/ICC and spent fuel pools	(2)
Diesel Generators	Provide power for PAM; provide power for FAPCS and support systems	(2), (3)
DPS	Diverse actuation of ECCS functions	(1) (3)
Drywell Hatches	Provide boundary for recovering vessel level following a shutdown LOCA below top of fuel event	(3)
Electrical Building HVAC	Provide post-72-hour cooling for diesel generators and Class 1E electrical distribution equipment; provide support for electrical power to FAPCS	(2), (3)
External Connection	Provide post-7-day refill to PC/ICC and spent fuel pools	(2)
FAPCS	Suppression pool cooling and low-pressure coolant injection modes	(3)
Fuel Building HVAC	Provide cooling support for FAPCS	(3)
FWRB	Run feedwater demand to minimum on ATWS signal	(1)
PAM Digital Instrumentation	PAM	(2)
Plant Investment Protection Buses	Provides post-72-hour ac power from standby diesel generators to support PAM, and FAPCS	(2)
Plant Service Water System	Provide post-72-hour cooling for RCCWS; provide cooling support for FAPCS	(2), (3)
Reactor Building HVAC	Provide post-72-hour cooling for digital instrumentation	(2)
Reactor Closed Cooling Water System	Provide post-72-hour cooling for chillers and diesel generators Provide cooling support for FAPCS	(2), (3)
SLC System	Backup actuation logic to initiate	

SSC	Mission(s)	RTNSS Criterion (as defined in Section 22.2)
Actuation	SLC system and isolate RWCU/SDC	(1)
Turbine Building HVAC	Provide post-72-hour cooling for digital instrumentation in the turbine building; provide room cooling for RCCW pumps	(2), (3)

The applicant stated in ESBWR DCD Tier 2, Revision 4, Section 19A.8.2, that all RTNSS systems shall be in the scope of the D-RAP, as directed by ESBWR DCD Tier 2, Revision 4, Chapter 17. The D-RAP will be incorporated into the COL holder's Maintenance Rule program, which is regulated in accordance with 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." As discussed in ESBWR DCD Tier 2, Revision 4, Section 17.4.6, the Maintenance Rule program addresses key elements as they relate to the treatment of SSCs within the scope of the program—organization, design control, procedures, corrective action, records, and audits. This program also includes a process for evaluating the risk significance of the SSCs within the scope of the program.

In ESBWR DCD Tier 2, Revision 4, Section 19A.8.1, the applicant described its method for determining whether TSs or a separate process outside of TSs will control the availability of non-safety-related SSCs requiring regulatory oversight. The applicant's decision process relies on the results of the focused PRA, and in particular on focused PRA sensitivity studies that show the importance of SSC functions in keeping CDF and LRF below the Commission's established goals. In these focused PRA studies, each RTNSS system was failed with all other RTNSS equipment credited. In cases where the result exceeded a CDF or LRF goal, the SSC was identified as risk significant and requiring AC by TS. The only RTNSS function satisfying this criterion was the diverse actuation of ECCS functions, which the DPS controls. The ACM, discussed in Section 22.5.9 of this report, addresses the AC of the other RTNSS systems.

22.5.7.2 Regulatory Criteria

The regulatory criteria include (1) 10 CFR 50.36(c)(2)(ii)(D), which requires that a TS LCO of a nuclear reactor must be established for an SSC that operating experience or a PRA has shown to be significant to public health and safety, and (2) RG 1.206, which describes the scope, criteria, and process used to determine RTNSS in the passive plant designs.

22.5.7.3 Staff Evaluation

The mission of the DPS is to provide diverse actuation functions that will enhance the plant's ability to mitigate dominant accident sequences involving the common-cause failure of actuation logic or controls. In ESBWR DCD Tier 2, Revision 4, Section 19A.8.4.5, the applicant stated that it would include a TS LCO in ESBWR DCD Tier 2, Revision 4, Chapter 16. In light of the results of the focused PRA and the requirements of 10 CFR 50.36(c)(2)(ii)(D), the staff finds this acceptable.

The staff has reviewed the mission statements for SSCs provided in ESBWR DCD Tier 2, Revision 4, Section 19A.8.4. They encompass a complete list of RTNSS-important, non-safety-related SSCs that resulted from the evaluation using the RTNSS process and are therefore acceptable.

The NRC staff reviewed the provisions in the ESBWR DCD for the oversight of non-safety-related SSCs. In RAI 22.5-16, the staff asked the applicant to provide additional information regarding the treatment of several systems and components. The applicant provided a response for each of those systems or components and referred to the ACM or other DCD sections. The references for those systems focus on TSs rather than treatment provisions. In Supplement 1 to RAI 22.5-16, the staff asked the applicant to clarify the treatment provisions for RTNSS SSCs. By letter dated March 24, 2008, GEH provided a response to RAI 22.5-16 S01 providing additional clarification of the treatment provisions of the RTNSS SSCs. The staff is reviewing the applicant's response. **RAI 22.5-16 S01 is being tracked as an open item.**

ESBWR DCD Tier 2, Revision 4, Section 19A.2.1, states that most of the SLC system is safety-related and has sufficient regulatory oversight. In RAI 22.5-15, the NRC staff asked the applicant to clarify those portions of the SLC system that are non-safety-related and the regulatory oversight specified for those components. The staff also asked the applicant to discuss the basis for the determination that regulatory oversight of the SLC system is sufficient with portions of the SLC system categorized as non-safety-related. In response, GEH provided clarification of function of the non-safety-related portions of the SLC system. These portions include the subsystem for nitrogen charging of the accumulators, and the subsystem for boron mixing and makeup of the accumulators. These systems are not required for SLC to perform its safety-related function. They are used to maintain SLC readiness.

In Supplement 1 to RAI 22.5-15, the NRC staff requested the applicant to discuss the non-safety-related systems or components used to monitor the operational readiness of the SLC system and their consideration as part of the RTNSS program. In response to RAI 22.5-15 Supplement 1, the applicant stated that TSs control the operational readiness of the SLC system and supporting systems. This response was found acceptable and this RAI is now resolved.

The staff has reviewed the applicant's proposed reliability assurance program and documented its review in Section 17.4 of this report. The staff found that the reliability assurance program meets the guidance in Item E of SECY-95-132 and Section 17.4 of the NRC's draft Standard Review Plan.

Because of the open items that remain to be resolved for this section, the staff was unable to finalize its conclusions regarding acceptability.

22.5.8 Technical Specifications

As discussed in Section 22.5.7, the applicant has committed to include a TS LCO in ESBWR DCD Tier 2, Revision 4, Chapter 16, for non-safety-related functions of the DPS that have been determined to be risk significant. The applicant will provide the proposed TS for the DPS in DCD revision 5 for staff review. As a result, the staff was unable to finalize its conclusions regarding acceptability. **This is an open item.**

22.5.9 Short-Term Availability Controls

22.5.9.1 <u>Summary of Technical Information</u>

In ESBWR DCD Tier 2, Revision 4, Section 19A.8.1, the applicant proposed a means for implementing RTNSS controls in the form of administrative ACs for the SSCs summarized in ESBWR DCD Tier 2, Revision 4, Section 19A.8.4.1, and listed in ESBWR DCD Tier 2, Revision 4, Table 19A-2, except for the DPS manual controls, which the TSs will treat as discussed in Section 22.5.9.1. The ACM, which has been incorporated into ESBWR DCD Tier 2, Revision 4, Section 19ACM, documents the ACs.

22.5.9.2 Regulatory Criteria

The applicable criteria for establishing which RTNSS SSCs require TSs are the four screening criteria specified in 10 CFR 50.36(c)(2)(ii) for establishing LCOs. RG 1.206, which describes the scope, criteria, and process used to determine RTNSS in the passive plant design, provides guidance to applicants in establishing appropriate regulatory oversight for RTNSS SCCs including short-term availability controls if required for safety as determined by risk-significance.

22.5.9.3 Staff Evaluation

The ACs for RTNSS functions, which the ACM specifies as completion times, are established to ensure that the availability of each function is consistent with the functional unavailability in the ESBWR PRA. The surveillance requirements are also established to provide an adequate level of support to ensure that component performance is consistent with the functional reliability in the ESBWR PRA. Support systems inherit the ACs of the systems they support. This approach is consistent with the process for establishing RTNSS described in RG 1.206 and summarized in Section 22.3.6, and therefore it is acceptable. The ACs of the RTNSS-important SSCs are formatted similar to the TSs with availability requirements, applicability, actions and completion times (if availability requirements are not met), surveillance requirements, and bases. There are no requirements to bring the plant to a safe-shutdown condition when availability requirements are not fulfilled and completion times for required actions are not met. The staff finds this acceptable since (1) these RTNSS-important non-safety-related SSCs do not meet any of the regulatory criteria stated in 10 CFR 50.36(c)(2)(ii) for inclusion in TSs, and (2) the ESBWR D-RAP, as described in ESBWR DCD Tier 2, Section 17.4, includes these RTNSS-important SSCs, which will ensure that COL holders will monitor and control the availability and reliability of these SSCs in accordance with 10 CFR 50.65.

The staff has reviewed the individual ACs for RTNSS systems as described in the ACM and identified several issues, as described below.

The staff found that ACs did not state the associated instrumentation functions and the number of required divisions in the AC LCOs for the following functions:

- AC 3.3.1 (ARI)
- AC 3.3.2 (ATWS/SLC system actuation)
- AC 3.3.3 (FWRB)
- AC 3.3.5 (ADS inhibit)
- AC 3.5.1 (GDCS deluge function)

In addition, the AC bases do not explicitly state the minimum level of system degradation that corresponds to a function being unavailable, or the number of divisions used to determine the test interval for each required division (or component) for AC surveillance requirements (e.g., logic system functional test) that specify a frequency of 24 months on a staggered test basis. In RAI 22.5-22, the staff requested that GEH address these inconsistencies.
RAI 22.5-22 is being tracked as an open item.

The staff identified questions regarding the AC for the FAPCS. The applicant did not include an AC surveillance requirement for the pumps in the FAPCS. These pumps serve the low-pressure injection function, which the applicant has identified as an RTNSS system. In addition, the AC LCO specifies that only one train of FAPCS needs to be available during operation, which is inconsistent with the applicant's focused PRA that models the availability of two trains. The staff requested the applicant to address these inconsistencies in RAI 22.5-23. **RAI 22.5.23 is being tracked as an open item.**

The staff identified questions regarding the AC for the standby diesel generators similar to those described above for the FAPCS. In particular, the AC LCO specifies that only one standby diesel generator needs to be available, which is inconsistent with the applicant's focused PRA that models the availability of two standby diesels. In addition, the AC permits the standby diesel generator to be unavailable for a period of 14 days, which is seven (7) days longer than the period for a system that it supports (i.e., the FAPCS). The staff requested the applicant to address these inconsistencies in RAI 22.5-24. **RAI 22.5-24 is being tracked as an open item.**

22.5.9.4 Conclusions

Because of the open items that remain to be resolved for this section, the staff was unable to finalize its conclusions regarding acceptability.

22.5.10 Staff Conclusions

The staff has reviewed the applicant's implementation of the RTNSS process described in ESBWR DCD Tier 2, Revision 4, Section 19A, and finds that in most respects the applicant's implementation satisfies the scope, criteria, and process described in SECY-94-084, SECY-94-132, and RG 1.206 and summarized above in Sections 22.2 and 22.3. However, because of the open items that remain to be resolved, the staff was unable to finalize its conclusions regarding acceptability.

22.7 References

22-1 RG 1.206, "Combined License Applications for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, June 2007.

22-2 NEDO-33201, "ESBWR Probabilistic Risk Assessment," Sections 13, 14, and 15, Revision 2, September 2007.

22-3 SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs," U.S. Nuclear Regulatory Commission, March 28, 1994.

22-4 SECY-95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs," U.S. Nuclear Regulatory Commission, May 22, 1995.

22-5 NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 19.0, Revision 2, "Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors," U.S. Nuclear Regulatory Commission, June 2007.

22-6 Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," of the *Code of Federal Regulations*, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," U.S. Nuclear Regulatory Commission.

22-7 "2003 International Building Code," International Code Council, 2003.

22-8 RG 1.59, "Design Basis Floods for Nuclear Power Plants", Revision 1, U.S. Nuclear Regulatory Commission, August 1977.

22-9 RG 1.102, "Flood Protection for Nuclear Power Plants," Revision 1, U.S. Nuclear Regulatory Commission, September 1976.

22-10 IEEE Std 323, "Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, September 2003.

22-11 IEEE Std 344, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Revision 4, Institute of Electrical and Electronics Engineers, December 2004.

22-12 SECY-96-128, "Policy and Key Technical Issues Pertaining to the Westinghouse AP600 Standardized Passive Reactor Design," U.S. Nuclear Regulatory Commission, June 12, 1996.

22-13 FEMA 450, "2003 NEHRP Recommended Provisions for Seismic Regulations of New Buildings and Other Structures," Federal Emergency Management Agency, June 2004.

22-14 ASCE/SEI 7-02, "Minimum Design Loads for Buildings and Other Structures," American Society of Civil Engineers/Structural Engineering Institute, 2002.