C.I.9 Auxiliary Systems

Chapter 9 of the FSAR should provide information about the facility's auxiliary systems. In particular, this chapter should identify systems that are essential for safe shutdown of the plant or for protection of the health and safety of the public. For each system, the description should provide the design bases for the system and its critical components, a safety evaluation demonstrating how the system satisfies the design bases, the testing and inspection to be performed to verify system capability and reliability, and the required instrumentation and controls. For systems that have little or no role in protecting the public against exposure to radiation, the description should provide enough information to allow the NRC staff to understand the design and operation and their effect on reactor safety, with emphasis on those aspects of design and operation that might affect the reactor and its safety features or contribute to the control of radioactivity.

In addition, the information provided (e.g., a failure analysis) should clearly show the system's capability to function without compromising the safe operation of the plant under both normal operating and transient situations.

The applicant should state seismic design classifications with reference to detailed information provided in Chapter 3 of the FSAR, where appropriate. The applicant should also summarize radiological considerations associated with the operation of each system under normal and accident conditions, where applicable, with reference to detailed information in Chapters 11 or 12, as appropriate.

C.I.9.1 Fuel Storage and Handling

C.I.9.1.1 *Criticality Safety of Fresh and Spent Fuel Storage and Handling*

C.I.9.1.1.1 *Design Bases*

The applicant should provide the design bases for new and spent fuel storage facilities, including such considerations as quantity of fuel to be stored, means for maintaining a subcritical array, the degree of subcriticality provided for the most reactive condition possible together with the methods, approximations and assumptions used in this analysis.

C.I.9.1.1.2 *Facilities Description*

The applicant should provide a description of the new and spent fuel storage facilities, including drawings, and their locations in the station complex.

C.I.9.1.1.3 *Safety Evaluation*

The applicant should provide an evaluation of the capability of the new and spent fuel storage facilities to reduce the probability of occurrence of unsafe conditions. This evaluation should include consideration of the degree of subcriticality for all normal and credible abnormal conditions that could involve the storage and handling of fresh and spent fuel. The evaluation should include descriptions of the methods used, approximations and assumptions made, and handling of design tolerances and uncertainties.

Additional guidance regarding acceptable design of the spent fuel storage facilities is given in RG 1.13.

C.I.9.1.2 *New and Spent Fuel Storage*

C.I.9.1.2.1 ***Design Bases***

This section should provide the design bases for the new and spent fuel storage facilities, including such considerations as quantity of fuel to be stored, the configuration of the storage facilities, and the design of the storage racks. This information should address measures to prevent drainage of spent fuel storage areas, measures to prevent flooding of dry new fuel storage areas, circulation of coolant through the storage racks, shielding requirements, design loadings to be withstood, and protection against natural phenomena and internal missiles.

C.I.9.1.2.2 ***Facilities Description***

This section should provide a description of the spent fuel storage facilities, including drawings, and their location in the station complex.

C.I.9.1.2.3 ***Safety Evaluation***

The applicant should provide an evaluation of the protection of the spent fuel storage facilities against unsafe conditions. This evaluation should include the following considerations:

- governing codes for design
- protection against natural phenomena
- ability to withstand design loads and forces
- design features (e.g., weirs and gates) to maintain an adequate coolant inventory in spent fuel storage areas under normal and accident conditions
- design features (e.g., drains) to prevent flooding of dry new fuel storage areas
- effectiveness of coolant circulation through the racks in cooling the stored fuel
- pool liner leak collection and control features
- configuration of fuel storage pool and associated handling areas to preclude accidental dropping of heavy objects on spent fuel
- material compatibility requirements
- radiological shielding design including water levels for shielding (present details in FSAR Chapter 12)
- ability of the fuel storage racks to withstand accident forces associated with fuel handling
- safety implications related to sharing (for multi-unit facilities)

RG 1.13 gives additional guidance on the acceptable design of the spent fuel storage facilities.

C.I.9.1.3 *Spent Fuel Pool Cooling and Cleanup System*

C.I.9.1.3.1 ***Design Bases***

The applicant should provide the design bases for the cooling and cleanup system for the spent fuel facilities, including the following considerations:

- pool cleanliness requirements for normal operations
- the heat generation rate of the stored fuel
- the heat removal paths for normal and accident conditions
- protection of essential components against natural phenomena and internal missiles
- the capability of essential components to withstand design loadings
- pool water temperature limits for normal and accident conditions
- provisions to preclude inadvertent or accidental draining or siphoning of pool coolant
- provisions to collect system leakage and instrumentation to indicate water level and temperature
- radiation levels under normal and anticipated accident conditions

C.I.9.1.3.2 ***System Description***

The applicant should provide a detailed description and drawings of the cooling and cleanup system, including the instrumentation and alarms.

C.I.9.1.3.3 ***Safety Evaluation***

The applicant should provide an evaluation of the cooling system, including the following considerations:

- capability to transfer the necessary heat to an UHS under normal and accident conditions without exceeding specified spent fuel pool water temperatures
- capability of the makeup water system to maintain adequate pool water level for cooling and shielding requirements under normal and accident conditions
- provision of passive design features to ensure that the pool water level will not be inadvertently reduced below the minimum level necessary for adequate cooling and shielding
- the ability to maintain acceptable pool water conditions for fuel handling and to maintain occupational exposure as low as reasonably achievable
- capability to withstand design loads and forces
- protection of essential components from the effects of natural phenomena
- provision of features to collect system leakage
- safety implications related to sharing (for multi-unit facilities)

FSAR Chapters 11 and 12 should present the radiological evaluation of the pool cleanup system.

C.I.9.1.3.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the cooling and cleanup system.

C.I.9.1.3.5 ***Instrumentation Requirements***

The applicant should describe system instrumentation, including instrumentation to indicate water level, temperature, and radiation levels under normal and anticipated accident conditions.

C.I.9.1.4 *Light-Load Handling System (Related to Refueling)*

C.I.9.1.4.1 ***Design Bases***

The applicant should provide the design bases for the fuel handling system (FHS), including the load handling requirements, handling control features, and provisions to prevent fuel handling accidents.

C.I.9.1.4.2 ***System Description***

The applicant should provide a description of the FHS, including all components for transporting and handling fuel from the time it reaches the plant until it leaves the plant. The applicant should provide an outline of the procedures used in new fuel receipt and storage, reactor refueling operations, and spent fuel storage and shipment. Toward that end, the FSAR should also provide component drawings, building layouts, and illustrations showing important aspects of the fuel handling process. For example, illustrations and component drawings should show the arrangement of equipment for fuel movement within the reactor and the equipment used for fuel transfer. Include detailed descriptions and drawings, and provide the design data, seismic category, and quality class for all principal components. Also identify the design codes and standards used for design, manufacture, testing, operation, maintenance, and seismic design aspects.

C.I.9.1.4.3 ***Safety Evaluation***

The applicant should provide an evaluation of the FHS, including the system's capability to preclude unacceptable releases of radiation as a result of mechanical damage to fuel, maintain an adequate degree of subcriticality, and maintain acceptable shielding during fuel handling. This evaluation should consider the design of components and mechanisms to withstand earthquakes and interlocks and design features to ensure that the applicant will perform fuel handling within acceptable limits.

C.I.9.1.4.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for FHS subsystems and components, including shop tests, preoperational tests, and periodic operational tests.

C.I.9.1.4.5 ***Instrumentation Requirements***

The applicant should describe the system I&C, alarms, and communication system(s). Include a description of the adequacy of safety-related interlocks to meet the single-failure criterion.

C.I.9.1.5 *Overhead Heavy-Load Handling System*

C.I.9.1.5.1 ***Design Bases***

The applicant should provide the design bases for the overhead heavy-load handling system with respect to critical load handling evolutions. Critical load handling evolutions are those handling evolutions with the potential for inadvertent operations or equipment malfunctions to affect the handling system in the following ways:

- cause a significant release of radioactivity
- cause a loss of margin to criticality

- uncover irradiated fuel in the reactor vessel or spent fuel pool
- damage equipment essential to achieve or maintain safe shutdown

Necessary information includes parameters defining the load that, if dropped, would cause the greatest damage; the areas of the plant where the load would be handled; the design of the overhead heavy-load handling system; and the operating, maintenance, and inspection procedures applied to the load handling system. A heavy load is defined as a load weighing more than one fuel assembly and its associated handling device.

C.I.9.1.5.2 ***System Description***

The applicant should provide a description of the overhead heavy-load handling system, including component drawings, building layouts, and illustrations of special lifting devices. For all principal components, provide the relevant design data, seismic category, and quality class, and identify the design codes and standards used for design, manufacture, testing, operation, maintenance, and seismic design aspects.

C.I.9.1.5.3 ***Safety Evaluation***

The applicant should provide an evaluation of the overhead heavy-load handling system in satisfying the objectives of Section 5.1 of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," including the following capabilities:

- preclude unacceptable releases of radiation through mechanical damage to fuel
- prevent damage that could threaten the ability to maintain an adequate degree of subcriticality
- prevent damage that could result in uncovering fuel in the reactor vessel or spent fuel pool
- prevent damage that alone could result in a loss of essential safe-shutdown functions

This evaluation should describe the extent of conformance with the general load handling practices of Section 5.1.1 of NUREG-0612 and describe design features or analyses demonstrating that the design will achieve the objectives of Section 5.1 of NUREG-0612. These design features and analyses may include one or more of the following:

- mechanical stops or electrical interlocks to preclude load drops in critical areas
- analyses of potential load drops demonstrating that the system would satisfy the objectives in the event of a load drop
- a highly reliable load handling system to assure a low probability of a load drop in a critical area.

C.I.9.1.5.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the overhead heavy-load handling system components, including shop tests, preoperational tests, and periodic operational tests and inspections.

C.I.9.1.5.5 ***Instrumentation Requirements***

The applicant should describe the system I&C, alarms and communication system(s), and the adequacy of safety-related interlocks to meet the single-failure criterion.

C.I.9.2 <u>Water Systems</u>

This section of the FSAR should discuss each of the plant's water systems. Because these auxiliary water systems vary in number, type, and nomenclature for various plant designs, the standard format does not assign specific subsection numbers to these system discussions. The applicant should provide separate subsections (numbered 9.2.1 through 9.2.x) for each of the systems.

The following paragraphs provide examples of systems to be discussed, as appropriate to the individual plant, and identify some specific information to be provided. These examples are not intended to represent a complete list of systems to be discussed in this section.

C.I.9.2.1 *Station Service Water System (Open, Raw Water Cooling Systems)*

C.I.9.2.1.1 *<u>Design Bases</u>*

The applicant should provide the design bases for the service water system, including the following considerations:

- cooling requirements for normal and accident conditions
- capability to provide essential cooling for normal and accident conditions, assuming a single active failure
- capability to provide essential cooling using either offsite power supplies or onsite emergency power supplies
- capability to isolate nonessential portions of the system
- protection of essential components against natural phenomena and internal missiles
- capability of essential components to withstand design loadings
- provisions for inspection and functional testing of essential components and system segments
- provisions to detect leakage of radioactive material into the system and control leakage out of the system
- provisions to protect against adverse environmental, operating, and accident conditions that can occur, such as freezing, thermal overpressurization, and waterhammer
- capability of the system to function at the lowest probable water level of the UHS

C.I.9.2.1.2 *<u>System Description</u>*

The applicant should provide a detailed description and drawings of the service water system, including components cooled by the system, nonessential components that may be isolated from the service water system, cross-connection capability between trains and units, and instrumentation and alarms.

C.I.9.2.1.3 *<u>Safety Evaluation</u>*

The applicant should provide an evaluation of the service water system, including the following considerations:

- capability to transfer the necessary heat to an UHS under normal and accident conditions assuming a single active failure, with and without offsite power available

- capability to isolate nonessential portions of the system
- the protection of essential components against natural phenomena and internal missiles
- capability of essential components to withstand design loadings and adverse environmental, operating, and accident conditions
- capability of the system to function during adverse environmental conditions and abnormally high and low water levels
- measures used to prevent long-term corrosion and organic fouling that may degrade system performance
- safety implications related to sharing of systems that can be cross-tied (for multi-unit facilities)

C.I.9.2.1.4 *Inspection and Testing Requirements*

The applicant should describe the inspection and testing requirements for the service water system, including ISI and testing, inspection and testing necessary to demonstrate that the applicant will effectively manage fouling and degradation mechanisms applicable to the site to maintain acceptable system performance and integrity, and periodic flow testing though normally isolated safety-related components and infrequently used cross-connections between trains/units.

C.I.9.2.1.5 *Instrumentation Requirements*

The applicant should describe the system alarms, instrumentation, and controls. This description should include the adequacy of instrumentation to support required testing, as well as the adequacy of alarms to notify operators of degraded conditions.

C.I.9.2.2 *Cooling System for Reactor Auxiliaries (Closed Cooling Water Systems)*

C.I.9.2.2.1 *Design Bases*

The applicant should provide the design bases for the reactor auxiliaries cooling system, including the following considerations:

- cooling requirements for normal and accident operations
- capability to provide essential cooling for normal and accident conditions assuming a single active failure
- capability to provide essential cooling using either offsite power supplies or onsite emergency power supplies
- capability to isolate nonessential portions of the system
- protection of essential components against natural phenomena and internal missiles
- capability of essential components to withstand design loadings
- provisions to protect against adverse environmental, operating, and accident conditions that can occur, such as thermal overpressurization and waterhammer
- provisions for inspection and functional testing of essential components and system segments
- provisions to detect and control leakage of radioactive material into or out of the system

- provisions to withstand loss of pressure boundary integrity in one train and expected long-term leakage without a loss of system functional capability

C.I.9.2.2.2 ***System Description***

The applicant should provide a detailed description and drawings of the reactor auxiliaries cooling system, including the components cooled by the system, nonessential components that may be isolated, cross-connection capability between trains and units, and instrumentation and alarms.

C.I.9.2.2.3 ***Safety Evaluation***

The applicant should provide an evaluation of the reactor auxiliaries cooling system, including the following considerations:

- capability to transfer the necessary heat to an UHS under normal and accident conditions assuming a single active failure, with and without offsite power available
- capability to isolate nonessential portions of the system
- protection of essential components against natural phenomena and internal missiles
- capability of essential components to withstand design loadings and adverse environmental, operating, and accident conditions
- prevention of long-term corrosion that may degrade system performance
- safety implications related to sharing (for multi-unit facilities)
- capability to withstand loss of pressure boundary integrity in one train and expected long-term leakage without a loss of system functional capability

For plants that rely on auxiliary cooling of pump seals to control leakage from the RCS, describe provisions to maintain pump seal integrity during SBO conditions.

C.I.9.2.2.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the reactor auxiliaries cooling system, including ISI and testing.

C.I.9.2.2.5 ***Instrumentation Requirements***

The applicant should describe the system alarms, instrumentation, and controls. Include a description of the adequacy of instrumentation to support required testing, as well as the adequacy of alarms to notify operators of degraded conditions.

C.I.9.2.3 ***[Reserved]***

C.I.9.2.4 ***Potable and Sanitary Water Systems***

The applicant should provide a description of the potable and sanitary water systems. This description should include system design criteria addressing prevention of connections to systems having the potential to contain radioactive material.

C.I.9.2.5 *Ultimate Heat Sink*

C.I.9.2.5.1 ***Design Bases***

The applicant should provide the design bases for the UHS, including the following considerations:

- conservative estimates for heat rejection requirements for normal and accident operations
- capability to reject the necessary heat for normal and accident conditions assuming a single active failure
- capability to reject the necessary heat using either offsite power supplies or onsite emergency power supplies
- protection of essential structures and components against natural phenomena
- capability of essential components to withstand design loadings
- provisions for inspection of essential structures and subsystems
- provisions to protect against adverse environmental conditions such as freezing
- provisions to maintain an adequate cooling water inventory at an acceptable temperature for 30 days without makeup

C.I.9.2.5.2 ***System Description***

The applicant should provide a detailed description and drawings of the UHS, including water inventory, temperature limits, heat rejection capabilities under limiting conditions, instrumentation, and alarms. This description should discuss the extent to which the design of the UHS meets the requirements of the following GDC, as set forth in Appendix A to 10 CFR Part 50:

- GDC 2, "Design bases for protection against natural phenomena"
- GDC 5, "Sharing of structures, systems, and components"
- GDC 44, "Cooling Water"
- GDC 45, "Inspection of Cooling Water System"
- GDC 46, "Testing of Cooling Water System"

In addition, this description should provide details concerning the applicability and use of guidance given in RG 1.27, RG 1.72, "Spray Pond Piping Made from Fiberglass-Reinforced Thermosetting Resin," and ANSI/ANS 5.1, "Decay Heat Power for Light Water Reactors."

C.I.9.2.5.3 ***Safety Evaluation***

The applicant should provide an evaluation of the UHS, including the following considerations:

- capability to reject the necessary heat under normal and accident conditions, assuming a single active failure
- capability to retain an adequate inventory at an acceptable temperature without makeup for 30 days
- protection of essential structures and components against natural phenomena

- capability of essential components to withstand design loadings
- capability of the system to function during adverse environmental conditions
- measures used to prevent long-term fouling and mitigate short-term clogging anticipated at the site that may degrade system performance
- safety implications related to sharing of the UHS (for multi-unit facilities)

C.I.9.2.5.4 *Inspection and Testing Requirements*

The applicant should describe the inspection and testing requirements for the UHS, including inspection and testing necessary to demonstrate that the applicant will effectively manage fouling and degradation mechanisms applicable to the site to maintain acceptable heat sink performance and integrity.

C.I.9.2.5.5 *Instrumentation Requirements*

The applicant should describe the system alarms, instrumentation, and controls.

C.I.9.2.6 *Condensate Storage Facilities*

C.I.9.2.6.1 *Design Bases*

The applicant should provide the design bases for the condensate storage facilities, including the following considerations:

- capability to supply water at an adequate suction head to systems that are important to safety and used for RHR at high temperature
- capability to provide water for RHR under normal and accident conditions assuming a single active failure
- capability to isolate nonessential portions from essential portions of the system
- protection of essential components against natural phenomena and internal missiles
- capability of essential components to withstand design loadings
- automatic switching from nonsafety-related to safety-related sources of water under accident conditions
- provisions for inspection and functional testing of essential components and system segments
- capability to collect potentially radioactive water leakage

C.I.9.2.6.2 *System Description*

The applicant should provide a description of the condensate storage facilities, including the condensate storage tanks, nonessential components that may be isolated, automatic switching to safety-related water sources (if required), leakage collection features, and instrumentation and alarms.

C.I.9.2.6.3 *Safety Evaluation*

The applicant should provide an evaluation of the condensate storage facilities, including the following considerations:

- capability of the system to supply condensate at an adequate rate and pressure under normal and accident conditions assuming a single active failure
- capability to automatically switch to safety-related water sources (if necessary)
- capability to isolate nonessential portions of the system
- protection of essential components against natural phenomena and internal missiles
- capability of essential components to withstand design loadings
- safety implications related to sharing (for multi-unit facilities)
- adequacy of stored inventory for coping with both safe shutdown and SBO

FSAR Chapters 11 and 12 should evaluate the leakage collection features to preclude inadvertent release of radioactive water to the environment.

C.I.9.2.6.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the condensate storage facilities, including ISI and testing.

C.I.9.2.6.5 ***Instrumentation Requirements***

The applicant should describe the condensate storage system alarms, instrumentation, and controls. This description should include the adequacy of instrumentation to support identification of inadequate storage inventory, automatic switching to a safety-related water source, and identification of minimum water level to supply adequate net positive suction head.

C.I.9.3 **Process Auxiliaries**

This section of the FSAR should discuss each of the auxiliary systems associated with the reactor process system. Because these auxiliary systems vary in number, type, and nomenclature for various plant designs, the standard format does not assign specific subsection numbers to these systems. The applicant should provide separate subsections (numbered 9.3.1 through 9.3.x) for each of the systems. For each system, these subsections should provide the following information:

- design bases, including the GDC to which the system is designed
- system description
- safety evaluation
- testing and inspection requirements
- instrumentation requirements

The following paragraphs provide examples of systems that the section should discuss, as appropriate to the individual plant, and identify some specific information that the section should provide in addition to the items identified above. These examples are not intended to represent a complete list of systems to be discussed in this section. For example, the applicant should discuss both the boron recovery system and failed fuel detection system in this section.

C.I.9.3.1 *Compressed Air Systems*

The applicant should describe the compressed air systems that provide station air for service and maintenance uses, and include discussion of provisions for meeting the single-failure criterion for safety-related compressed air systems, air cleanliness and quality requirements, and environmental design requirements. Include a description of the capabilities to interconnect and/or isolate the instrumentation and control air system from the station service air system if the design provides two such systems that can be interconnected.

The description of the compressed air system should include a failure analysis (including diverse sources of electric power), the maintenance of air cleanliness to ensure system reliability, the capability to isolate the system, if required, and safety implications related to sharing (for multi-unit plants). Include in the failure analyses a description of the system's capability to function in the event of adverse environmental phenomena, abnormal operational, or accident conditions such as a LOCA, main steam line break concurrent with LOOP, and SBO. Address the potential for overpressurization of air-supplied components.

The applicant should describe the I&C features to determine and ensure that the system is operating correctly, including the means to detect leakage from radioactive systems to the I&C air system and to preclude releases to the environment.

The applicant should describe the provisions for periodic testing of air quality, testing of pressure and leakage, and any necessary periodic functional testing of the safety-related portions of the I&C air system.

C.I.9.3.2 *Process and Postaccident Sampling Systems*

The applicant should describe the sampling system for the various plant fluids.

Include consideration of sample size and handling necessary to ensure that a representative sample is obtained from liquid and gaseous process streams and tanks. The applicant should describe provisions for purging sampling lines and reducing plateout in sample lines (e.g., heat tracing). The applicant should describe provisions to purge and drain sample streams back to the system of origin, or to an appropriate waste treatment system, to minimize personnel exposure.

The applicant should describe provisions for isolating the system and the means to limit reactor coolant losses; requirements to minimize, to the extent practical, hazards to plant personnel; and design of the system, including pressure, temperature, materials of construction, and code requirements.

The description should delineate process streams and points where samples will be obtained, along with the parameters to be determined through sampling (e.g., gross beta-gamma concentration, boric acid concentration). The applicant should describe measures to ensure that samples will be representative samples, and address the effect of sharing on plant safety (for multi-unit facilities).

Having the postaccident sampling system is not mandatory. However, although the process sampling system does not have postaccident sampling capability its design should allow for collection of highly radioactive samples provided the contingency plan exists for their handling, no decrease in the effectiveness of emergency plans occurs, radioactivity including iodines is monitored and the capability for sampling and analyzing hydrogen in the containment atmosphere exists.

C.I.9.3.3 *Equipment and Floor Drainage System*

The applicant should describe the drainage systems for collecting the radioactive effluent from high-activity and low-activity liquid drains from various specified equipment and buildings. Include piping and pumps from equipment or floor drains to the sumps, and any additional equipment that may be necessary to route effluents to the drain tanks and then to the radwaste system.

Discuss design considerations for precluding back-flooding of equipment in safety-related compartments, as well as preventing transfer of contaminated fluids to noncontaminated drainage systems.

Identify areas where the drainage system is used to detect leakage from safety systems or to identify conditions that are adverse to safety, such as excessive leakage that could compromise the capability of SSC to perform safety functions or could result in an uncontrolled release of radioactive material to the environment.

The applicant should describe the performance of interfacing reviews under the NUREG-0800 sections dealing with protecting drainage systems against flooding, internally and externally generated missiles, and high- or moderate-energy pipe breaks.

The applicant should describe the seismic and safety classifications of the various portions of the system. Identify those portions of the system that are classified as seismic Category I and Quality Group C.

FSAR Chapters 11 and 12 should present an evaluation of radiological considerations for normal operation and postulated spills and accidents, including the effects of sharing (for multi-unit plants).

C.I.9.3.4 *Chemical and Volume Control System (Including Boron Recovery System) (Pressurized-Water Reactors Only)*

C.I.9.3.4.1 *Design Bases*

The design bases for the CVCS and the boron recovery system should include the capability to (1) vary coolant chemistry for control of reactivity and corrosion, and (2) maintain the required RCS inventory and RCP seal water requirements. Considerations include the maximum and normal letdown flow rates, charging rates for both normal operation and maximum leakage conditions, boric acid storage requirements for reactivity control, water chemistry requirements, and boric acid and primary water storage requirements in terms of the maximum number of startup and shutdown cycles.

C.I.9.3.4.2 *System Description*

The applicant should provide a complete description of the system and components, including any piping and instrumentation diagrams. Include design data, seismic category, and quality class for all components. The applicant should describe the principles of both automatic and manual system operation for steady-state, transient, startup, shutdown, and accident conditions. The applicant should describe controls, design provisions, and automatic features for protection of ion exchange resin and other components, as applicable, from the effects of high temperature in the letdown line. Outline the operating procedures for the CVCS, including the controls for boron addition and primary coolant dilution.

Discuss reactor coolant water chemistry requirements. The applicant should describe temperature control provisions for line heat tracing and tank heating, including provision for alarm failures. The applicant should provide tables of system design parameters and component design data.

C.I.9.3.4.3 ***Safety Evaluation***

The applicant should provide a safety evaluation that addresses, at a minimum, the following considerations:

- design for safe operation, shutdown, and prevention/mitigation of postulated accidents, including the ability of the CVCS to provide sufficient capacity and capability to support the plant's ability to withstand, or cope with, as applicable, and recover from, a SBO
- adequacy of system boron inventory for bounding cold shutdown conditions including AOO
- provisions for ensuring that boric acid solutions remain soluble
- pumping capability of system for reactor coolant makeup, and for small pipe and component failures
- provisions for a leakage detection and control program in accordance with 10 CFR 50.34(f)(xxvi)
- design for limitation of radioactive releases to the environment within normal and accident limits
- justification for the component and piping seismic design category and quality class assigned
- results of failure modes and effects analyses for single-failure consideration if CVCS is used for prevention/mitigation of postulated accidents
- system provisions to prevent such vacuum conditions that could case wall inward buckling and failure in tanks that can contain primary system water
- compliance with GDC
- extent to which the applicant has followed applicable regulatory guides
- protection of essential portions of systems from failure of nonseismic Category I equipment and piping and also from the following events:
  - flooding
  - adverse environmental occurrences (e.g., hurricanes, tornadoes)
  - abnormal operational conditions, or accident conditions, such as the following:
    - internally and externally generated missiles
    - LOOP
    - the effects of high- and moderate-energy line failures

C.I.9.3.4.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the CVCS.

C.I.9.3.4.5 ***Instrumentation Requirements***

The applicant should describe the system I&C, including the adequacy of safety-related I&C to fulfill their functions.

C.I.9.3.5 *Standby Liquid Control System (Boiling-Water Reactors)*

C.I.9.3.5.1 ***Design Bases***

The applicant should provide the design bases for the SLCS, including the capability for reactor shutdown independent of the normal reactivity control system with a reasonable shutdown margin at any time during core life, system redundancy, and ability to periodically verify functional performance capability. For plants that take credit for the SLCS as an ECCS, the design bases for the SLCS should also include the system's capability to function as part of the ECCS network. Section C.I.6.3 of this regulatory guide specifies the information requested for the ECCS. Discuss the design with respect to its capability to detect, collect, and control system leakage and the capability to isolate portions of the system in case of excessive leakage or component malfunction.

C.I.9.3.5.2 ***System Description***

The applicant should provide a description of the system and components, including piping and instrumentation diagrams. The applicant should describe temperature control provisions for line heat tracing and tank heating, including provisions for alarm failures. The applicant should provide design data, seismic category, and quality class for all components. The applicant should describe the principles of system operation and testing.

C.I.9.3.5.3 ***Safety Evaluation***

The applicant should provide a safety evaluation discussing system storage capacity and the injection rate required to bring the reactor from rated power to cold shutdown at any time during core life with adequate margin for adverse factors, including xenon decay; elimination of steam voids; and allowance for imperfect mixing, leakage, and dilution. For plants that take credit for the system as an ECCS, include a discussion that addresses the system's capability to perform its function as part of the ECCS. (See Section C.I.6.3 of this regulatory guide for information requested with respect to ECCS.) Discuss provisions to prevent loss of solubility of borated solutions. Include the following considerations in the safety evaluation:

- adequacy of the component and piping seismic design category and quality class
- results of failure modes and effects analyses, with regard to the single-failure criterion for safe shutdown and prevention/mitigation of postulated accidents
- compliance with GDC
- extent to which the applicant has followed applicable regulatory guides
- protection of essential portions of systems from failure of nonseismic Category I equipment and piping and also from the following events:
  - flooding
  - adverse environmental occurrences (e.g., hurricanes, tornadoes)
  - abnormal operational conditions, or accident conditions, such as the following:
    - internally and externally generated missiles
    - LOOP
    - the effects of high- and moderate-energy line failures

C.I.9.3.5.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the SLCS, including periodic operational testing. Include a description of any inspection and testing and other reliability assurance requirements for applicable components, including motor-operated SLCS storage tank discharge valves, if these are part of the system design.

C.I.9.3.5.5 ***Instrumentation Requirements***

The applicant should describe the system I&C. Include provisions for operational testing and the I&C features to verify that the system is available to operate in the correct mode.

C.I.9.4 **Air Conditioning, Heating, Cooling, and Ventilation Systems**

The following subsections discuss examples of systems that the applicant should address, as appropriate to the individual plant, and identify some specific information that the applicant should provide. These examples are not intended to represent a complete list of systems to be discussed in this section. For example, this section should describe both the diesel building and the containment/ESF ventilation systems. For each system, these subsections should provide the following information:

- design bases, including the GDC to which the system is designed
- system description
- safety evaluation
- testing and inspection requirements
- instrumentation requirements

C.I.9.4.1 *Control Room Area Ventilation System*

C.I.9.4.1.1 ***Design Bases***

Discuss the design bases for the air handling and treatment system for the control room and other auxiliary rooms (e.g., relay rooms and emergency switchgear rooms) considered to be part of the control room envelope. Include the criteria and/or features that ensure the performance (e.g., flow rates, temperature limits, humidity limits, filtration) and reliability of the system (i.e., single failure, redundancy, seismic design, missile protection, environmental qualification) for all modes of operation, including normal, abnormal, SBO, and toxic gas modes. The design bases should also include requirements for manual or automatic actuation, system isolation, monitoring for radiation and/or toxic gas, and other controls essential to the performance of the system functions.

C.I.9.4.1.2 ***System Description***

The system description should include the system's major components, key parameters, essential controls, and operating modes. This description should also include a process flow diagram or piping and instrument diagram to enhance understanding of system operation and flow paths and tables showing the key parameters and features of major components. In addition, the description should address realignment of the system as a result of automatic actuation or operator action for all modes of operation, with reference to response to radiation, toxic gas, smoke and/or other actuation signals (i.e., LOCA signal).

C.I.9.4.1.3 ***Safety Evaluation***

Identify the safety objectives to be achieved by the control room area ventilation system. For example, one safety objective may be to confine, contain, or reduce contamination by isolation and filtering. Another may be to maintain acceptable zone temperature and humidity to prevent degradation of important equipment.

Discuss the manner in which the system achieves each safety objective. For example, for the objective of confinement, containment, or contamination reduction, the discussion may address the actuation signals and actions necessary to achieve system isolation or operation, as well as the system's capability to reduce contamination by high-efficiency particulate air (HEPA) or carbon filters.

Additional detailed discussion of control room ventilation systems should appear in Section 6.4 and in Chapter 15 of the applicant's FSAR.

C.I.9.4.1.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the control room area ventilation system, including ISI requirements for applicable components. Identify the inspection and testing programs to ensure that the system will meet its functional requirements, especially those that will be controlled through TS surveillance. For example, the applicant may need to confirm filter efficiencies, pressure drops, flow rates, and temperatures through test programs.

C.I.9.4.1.5 ***Instrumentation Requirements***

The applicant should describe the system I&C. Include provisions for operational testing and the I&C features to verify that the system is available to operate in the correct mode.

C.I.9.4.2 *Spent Fuel Pool Area Ventilation System*

C.I.9.4.2.1 ***Design Bases***

The design bases of the air handling and treatment system for the spent fuel pool area should include the criteria and/or features to ensure the system's performance (i.e., flow rates, temperature limits, humidity limits, filtration) and reliability (i.e., single failure, redundancy, seismic design, environmental qualification) for all modes of operation, including normal, abnormal, and SBO modes. The design bases should also include requirements for manual or automatic actuation, system isolation, monitoring for radiation and filtration, and other controls essential to the performance of the system functions.

C.I.9.4.2.2 ***System Description***

The system description should include the system's major components, key parameters, essential controls, and operating modes. This description should also include a process flow diagram or piping and instrument diagram to enhance understanding of system operation and flow paths and include tables showing the key parameters and features of major components. In addition, the description should address realignment of the system as a result of automatic actuation or operator action for all modes of operation with reference to response to radiation or other actuation signals (i.e., LOCA signal).

C.I.9.4.2.3 ***Safety Evaluation***

Identify the safety objectives to be achieved by the spent fuel pool area ventilation system. For example, one safety objective may be to confine, contain, or reduce contamination by isolation and filtering. Another may be to maintain an acceptable zone temperature and humidity to prevent degradation of important equipment.

Discuss the manner in which the system achieves each safety objective. For example, for the objective of confinement, containment, or contamination reduction, the discussion may address the actuation signals and subsequent equipment actuation, as well as the capability to reduce contamination by HEPA or carbon filters.

Include a discussion of the ability to (1) detect radiation in the area of the spent fuel pool and (2) filter the contaminants out of the air before exhausting it to the environment or prevent the contaminated air from leaving the spent fuel area.

C.I.9.4.2.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the spent fuel area ventilation system components important to safety. Identify the inspection and testing programs to ensure that the system will meet its functional requirements, especially those that will be controlled through TS surveillance. For example, the applicant may need to confirm filter efficiencies, pressure drops, flow rates, and temperatures through test programs.

C.I.9.4.3 *Auxiliary and Radwaste Area Ventilation System*

C.I.9.4.3.1 ***Design Bases***

The design bases for the air handling and treatment system for the radwaste area and areas of the auxiliary building containing safety-related equipment should include the criteria and/or features to ensure the system's performance (i.e., flow rates, temperature limits, humidity limits, filtration) and reliability (i.e., single failure, redundancy, seismic design, environmental qualification) for all modes of operation, including normal, abnormal, and SBO. Also describe requirements for manual or automatic actuation, system isolation, monitoring for radiation, and other controls essential to the performance of the system functions. Include, as appropriate, the preferred direction of airflow from areas of low potential radioactivity to areas of high potential radioactivity, any differential pressures to be maintained and measured, and any requirements for the treatment of exhaust air, during normal, abnormal, and accident conditions.

C.I.9.4.3.2 ***System Description***

The system description should include the system's major components, key parameters, essential controls, and operating modes. This description should also include a process flow diagram or piping and instrument diagram to enhance understanding of system operation and flow paths and tables showing the key parameters and features of major components. In addition, the description should address the realignment of the system as a result of automatic actuation or operator action for all modes of operation, with reference to response to radiation or other actuation signals (i.e., LOCA signal).

C.I.9.4.3.3 *Safety Evaluation*

The applicant should provide an evaluation of the auxiliary and radwaste area ventilation system. Identify the safety objectives to be achieved by the system. For example, one safety objective may be to confine, contain, or reduce contamination by isolation and filtering. Another may be to maintain an acceptable zone temperature and humidity to prevent degradation of important equipment.

Discuss the manner in which the system achieves each safety objective. For example, for the objective of confinement, containment, or contamination reduction, the discussion may address the actuation signals and subsequent equipment actuation, as well as the system's capability to reduce contamination by HEPA or carbon filters.

Chapters 11 and 12 of the FSAR should present the evaluation of radiological considerations for normal operation.

C.I.9.4.3.4 *Inspection and Testing Requirements*

The applicant should describe the inspection and testing requirements for the auxiliary and radwaste area ventilation system. Identify the inspection and testing programs to ensure that the system will meet its functional requirements, especially those that will be controlled through TS surveillance. For example, the applicant may need to confirm filter efficiencies, pressure drops, flow rates, and temperatures through test programs.

C.I.9.4.4 *Turbine Building Area Ventilation System*

C.I.9.4.4.1 *Design Bases*

The design bases for the air handling and treatment system for the turbine-generator area in the turbine building should include the criteria and/or features to ensure the system's performance (i.e., flow rates, temperature limits, humidity limits, filtration) and reliability (i.e., single failure, redundancy, seismic design, environmental qualification) for all modes of operation, including normal, abnormal, and SBO conditions. The design bases should also include requirements for manual or automatic actuation, system isolation, and other controls essential to the performance of system functions.

C.I.9.4.4.2 *System Description*

The system description should include the system's major components, key parameters, essential controls, and operating modes. This description should also include a process flow diagram or piping and instrument diagram to enhance understanding of system operation and flow paths. Tables should be included to show the key parameters and features of major components. In addition, the description should address the realignment of the system as a result of automatic actuation or operator action for all modes of operation with reference to response to radiation or other actuation signals. Identify which, if any, portions of the system are essential (classified as seismic Category I) and how those portions can be isolated from nonessential portions of the system.

C.I.9.4.4.3 *Safety Evaluation*

The applicant should provide an evaluation of the turbine building area ventilation system. This evaluation should include a system failure analysis (including effects of inability to maintain preferred airflow patterns). Identify the safety objectives to be achieved by the system. For example, one safety objective may be to confine, contain, or reduce contamination by isolation and filtering. Another may be to maintain acceptable zone temperature and humidity to prevent degradation of important equipment.

Discuss the manner in which the system achieves each safety objective. For example, for the objective of confinement, containment, or contamination reduction, the discussion may address the actuation signals and subsequent equipment actuation, as well as the capability of the system to reduce contamination by HEPA or carbon filters.

FSAR Chapters 11 and 12 should evaluate radiological considerations for normal operation.

C.I.9.4.4.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing requirements for the turbine building area ventilation system. Identify the inspection and testing programs to ensure that the system will meet its functional requirements, especially those that will be controlled through TS surveillance. For example, the applicant may need to confirm filter efficiencies, pressure drops, flow rates, and temperatures through test programs.

C.I.9.4.5 *Engineered Safety Feature Ventilation System*

C.I.9.4.5.1 ***Design Bases***

The design bases for the air handling and treatment system for areas that house ESF equipment should include the criteria and/or features to ensure the system's performance (i.e., flow rates, temperature limits, humidity limits, filtration) and reliability (i.e., single failure, redundancy, seismic design, environmental qualification) for all modes of operation, including normal, abnormal, and SBO conditions. The design bases should also include requirements for manual or automatic actuation, system isolation, monitoring for radiation, and other controls essential to the performance of the system functions. In addition, the applicant should provide details concerning the means used to protect system vents and louvers from externally and internally generated missiles.

C.I.9.4.5.2 ***Systems Description***

The system description should include the system's major components, key parameters, essential controls, and operating modes. This description should also include a process flow diagram or piping and instrument diagram to enhance understanding of system operation and flow paths and tables showing the key parameters and features of major components. In addition, the description should address the realignment of the system as a result of automatic actuation or operator action for all modes of operation with reference to response to radiation or other actuation signals (i.e., LOCA signal).

This description should identify all portions of the system that are determined to be seismic Category I and safety related. For these portions of the system, the system description should include the following considerations:

- capability of heating and cooling systems to maintain a suitable ambient temperature range in the areas serviced, assuming normal operation of the equipment in those areas
- capability of the safety features equipment in the serviced areas to function under the worst anticipated degraded performance of the ESF ventilation system
- capability of the system to circulate sufficient air to prevent accumulation of flammable or explosive gas or fuel-vapor mixtures from components such as storage batteries and stored fuel

- capability of the system to automatically actuate components not operating under normal operating conditions or to actuate standby components (redundant equipment) in the event of failure or malfunction
- capability of the system to actuate ventilation equipment in the areas containing ESF to maintain ambient temperatures within design rated temperatures for the components
- capability of the system to control airborne particulate material (dust) accumulation, and, as necessary, to detect and control leakage of radioactive contamination from the system to the environment

C.I.9.4.5.3 *Safety Evaluation*

The applicant should provide an evaluation of the ESF ventilation system. The evaluation should include a system failure analysis. Identify the safety objectives to be achieved by the system. For example, one safety objective may be to confine, contain, or reduce contamination by isolation and filtering. Another may be to maintain an acceptable zone temperature and humidity to prevent degradation of important equipment.

Discuss the manner in which the system achieves each safety objective. For example, for the objective of confinement, containment, or contamination reduction, the discussion may address the actuation signals and subsequent equipment actuation, as well as the capability to reduce contamination by HEPA or carbon filters.

If applicable, include the effect of redundant systems and address the safety implications related to sharing (for multi-unit plants).

C.I.9.4.5.4 *Inspection and Testing Requirements*

Identify the inspection and testing programs to ensure that the system will meet its functional requirements, especially those that will be controlled through TS surveillance. For example, the applicant may need to confirm filter efficiencies, pressure drops, flow rates, and temperatures through test programs.

C.I.9.5 Other Auxiliary Systems

This section includes examples of other systems important to the safe operation of the facility, such as fire protection systems, lighting, communication systems, and diesel generator auxiliary systems. The level of information to be provided will reflect the design bases for the system; therefore, the non-safety systems will likely have reduced discussion.

C.I.9.5.1 *Fire Protection Program*

Because the Fire Protection Program (FPP) is an operational program, as discussed in SECY-05-0197, the program and its implementation milestones should be fully described and reference any applicable standards. Fully described should be understood to mean that the program is clearly and sufficiently described in terms of the scope and level of detail to allow for a reasonable assurance finding of acceptability.

C.I.9.5.1.1 *Design Bases*

The applicant should provide the design bases for the FPP to demonstrate that the FPP satisfies the Commission's fire protection objectives through a defense-in-depth philosophy. SRP Section 9.5.1 and RG 1.189, "Fire Protection for Nuclear Power Plants," discuss the design bases for an acceptable FPP. At a minimum, the FSAR should include the following design bases:

- Overall FPP design bases to meet 10 CFR 50.48, "Fire Protection," as well as the criteria for new reactor enhanced fire protection in accordance with Appendix A to SRP Section 9.5.1.
- A list of the industry codes, standards, and guidance documents that will be the basis for the design, construction, testing, inspection and maintenance of the FPP, including the applicable edition date (which should be within 6 months of the COL application submittal date for plant-specific FPP features, or within 6 months of the design certification application, as applicable). The applicant should identify exceptions to the guidance and/or provisions included in these documents and provide the basis for each exception.
- The assumptions and bases for assumptions applied to analyses of fire-induced multiple spurious actuations that could prevent safe shutdown. This discussion should include the protection provided to ensure that one train of safe-shutdown SSC remains free of fire damage.
- The acceptance criteria for operator manual actions or recovery actions credited to achieve and maintain safe shutdown during and after a fire. The applicant should identify where it has credited operator manual or recovery actions and describe the associated fire scenario for each, as well as the analyses (including the appropriate thermo-hydraulic analysis) to demonstrate that safe shutdown can be achieved and maintained.

Some of this information may not be available or possible to provide at the time the COL application is submitted. In those cases, the applicant should submit the information that is available, justify its inability to provide the unavailable information in the COL application, and furnish details describing implementation plans, milestones, and sequences and/or ITAAC or commitments for developing, completing, and submitting this information during the construction period, prior to fuel receipt on site.

C.I.9.5.1.2 *System Description*

The applicant should provide a description of the FPP, including the fire protection system piping and instrumentation diagrams. SRP Section 9.5.1 describes the scope of the facility FPP and the related NRC-approved acceptance criteria. The applicant should describe each element of the FPP well enough to permit an independent assessment of the program's capability to satisfy the Commission's fire protection objectives. As a minimum, the system description should include the following:

- overall FPP provisions, including the fire protection organization; administrative policies; fire prevention controls; applicable administrative, operations, maintenance, and emergency procedures; QA; access to fire areas for fire fighting; and fire brigade and emergency response capability.
- evaluation of the FPP against RG 1.189 and SRP Section 9.5.1. This evaluation should identify and describe all differences between the facility's FPP design features, analytical techniques, and procedural measures, and those given in RG 1.189 and SRP Section 9.5.1. Where such differences exist, the evaluation should discuss how the proposed alternative provides an acceptable method of complying with applicable NRC rules or regulations that underlie RG 1.189 and SRP Section 9.5.1.

- provide a plant layout, facility site arrangement, and structural design features, which provide separation or isolation of redundant systems important to safety.
- selection and design of fire detection, alarm, control, and suppression on the basis of the fire hazards analysis; design, testing, qualification, inspection and maintenance of fire barriers; use of noncombustible materials; design of floor drains, ventilation, emergency lighting, and communication systems to the extent that they impact the FPP.
- cover fire protection and control provisions (for multi-unit sites) to maintain the integrity and operability of any shared fire protection systems and to ensure that fire hazards associated with one unit will not have an adverse effect on the adjacent unit(s).
- design features that prevent migration of smoke, hot gases, or fire suppressant material into other fire areas, causing adverse effects on safe-shutdown capabilities, including operator actions.
- any emergency backup functions performed by the fire protection system to support operation of safe-shutdown systems. This description should include the extent to which the facility relies on this backup function for safe shutdown (e.g., the backup function is required for safe shutdown or is provided only for additional defense in depth and is not essential to achieving or maintaining safe shutdown).
- the facility's design for smoke and heat control during a fire in areas important to safety.
- contain a description of any portions of the fire protection system that are designed to remain functional following a safe-shutdown earthquake and provisions for isolating those portions from the rest of the system.
- electrical cable and raceway penetrations in fire barriers and raceway fire barrier systems, including qualification tests and acceptance criteria.
- provide the schedule and detailed implementation plan for the FPP, to ensure that the program is properly established and implemented in time to provide adequate protection prior to fueling and operation of the nuclear power plant. The description should include the implementation plans to establish, train, and equip the site fire brigade to ensure adequate manual firefighting capability for areas with structures, systems, and components important to safety. As discussed in Section C.I.13.4 of this guide, applicants should provide implementation milestones for operational programs.

C.I.9.5.1.3 ***Safety Evaluation***

The applicant should provide a postfire, safe-shutdown analysis to demonstrate that the FPP satisfies the Commission's fire protection objectives, in accordance with the enhanced fire protection criteria for new reactors described in Appendix A to SRP Section 9.5.1. This analysis should include the list of systems and components needed to provide postfire safe-shutdown capability; the arrangement of the systems and components within the plant fire areas; the separation between redundant safe-shutdown systems and components; fire protection for safe-shutdown systems and components; and potential interactions between nonsafety systems, fire protection systems, and systems important to safety as they relate to potential adverse effects on the safe-shutdown capability. SRP Section 9.5.1 and RG 1.189 provide guidance for an acceptable FPP safety evaluation and supporting analyses. To support the safe-shutdown analysis, the applicant should provide a fire hazards analysis evaluating (1) the potential fire hazards for areas containing equipment important to safety throughout the plant, and (2) the effect of postulated fires and explosions relative to maintaining the ability to perform safe-shutdown functions and minimizing radioactive releases to the environment. The fire hazards analysis should specify measures for fire prevention, detection, suppression, and containment, as well as alternative shutdown capability for each fire area containing SSC important to safety in accordance with NRC guidelines and regulations.

Section C.I.19 of this regulatory guide offers guidance for fire PRA.

C.I.9.5.1.4 ***Inspection and Testing Requirements***

The applicant should provide a description of the inspection and testing requirements for the fire protection system for both initial system startup and periodic inspections and tests following startup.

C.I.9.5.2 ***Communication Systems***

C.I.9.5.2.1 ***Design Bases***

This section should provide design bases for the communication systems for intraplant and plant-to-offsite communications and should include a discussion of the use of diverse system types.

Address the integrated design of the system and related plant features to support effective communication between plant personnel in all vital areas of the plant during normal operation, as well as during accident or incident conditions under maximum potential noise levels or other conditions that could interfere with communication (e.g., electromagnetic interference).

FSAR Section 13.6 should discuss communications associated with security.

C.I.9.5.2.2 ***System Description***

The FSAR should provide a detailed description and evaluation of the communication systems, including drawings.

For all vital areas, the FSAR should address the environmental conditions including weather, moisture, noise level, and electromagnetic interference/radiofrequency interference that might interfere with effective communication. Environmental conditions also include fire and radiological events in which personnel must be able to communicate effectively while equipped with respiratory protection.

Section C.I.7.9 of this guide offers recommendations for data communication systems.

C.I.9.5.2.3 ***Inspection and Testing Requirements***

The applicant should provide inspection and testing requirements and any associated inspection/test procedures for the communication systems.

C.I.9.5.3 ***Lighting Systems***

The applicant should provide a description of the plant's normal, emergency, and supplementary lighting systems, including the capability of these systems to provide adequate lighting during all plant operating conditions (e.g., normal operation and anticipated fire, transient, and accident conditions). Discuss the effect of a loss of all alternating current power (i.e., during a SBO event) on emergency lighting systems. In the description of these lighting systems, include the following considerations:

- design criteria
- provisions for lighting needed in areas required for firefighting

- provisions for lighting needed in areas for control and maintenance of safety-related equipment
- access routes to and from these areas
- a failure analysis

C.I.9.5.4 *Diesel Generator Fuel Oil Storage and Transfer System*

C.I.9.5.4.1 *Design Bases*

The applicant should provide the design bases for the fuel oil storage and transfer system for the diesel generator, including the requirement for onsite storage capacity, capability to meet code design requirements, capability to detect and control system leakage, and environmental design bases.

C.I.9.5.4.2 *System Description*

The applicant should provide a description and drawings of the diesel generator fuel oil storage and transfer system.

C.I.9.5.4.3 *Safety Evaluation*

The applicant should provide an evaluation of the fuel oil storage and transfer system. This evaluation should include the potential for material corrosion and fuel oil contamination, a failure analysis to demonstrate the system's capability to meet design criteria (e.g., seismic requirements, capability to perform its function in the event of SBO, implications of sharing between units at a multi-unit site, ability to meet independence and redundancy requirements for onsite electric power supplies assuming a single failure), ability to withstand environmental design conditions, external and internal missiles and forces associated with pipe breaks, and the plans for procuring additional fuel oil and recharging storage tanks, if necessary.

C.I.9.5.4.4 *Inspection and Testing Requirements*

The applicant should describe the test and inspection procedures for the diesel generator fuel oil storage and transfer system.

C.I.9.5.5 *Diesel Generator Cooling Water System*

C.I.9.5.5.1 *Design Bases*

The applicant should provide the design bases for the diesel generator cooling water system, including the implications of shared systems, if any, on the system's capability to perform its function. Include the following considerations in the design-basis description:

- functional capability during high water levels (i.e., flooding, if applicable)
- capability to detect and control system leakage
- prevention of long-term corrosion and organic fouling and the compatibility of corrosion inhibitors or antifreeze compounds with materials of the system
- capacity of the cooling water system relative to manufacturer's recommended engine temperature differentials under adverse operating conditions
- provision of instruments and testing systems

- provisions to ensure that normal protective interlocks do not preclude engine operation during emergency conditions, if applicable
- discussion of the adequacy of the cooling water system to perform its function in the event of a SBO, if applicable
- provision of seismic Category I structures to house the system, if applicable

C.I.9.5.5.2 ***System Description***

The applicant should provide a description and drawings of the diesel generator cooling water system.

C.I.9.5.5.3 ***Safety Evaluation***

The applicant should provide an evaluation of the diesel generator cooling water system. Include in the failure analysis, as applicable, consideration of the ability to meet independence and redundancy requirements for onsite electric power supplies assuming a single-failure, internally or externally generated missiles, forces from piping cracks/breaks in high- and moderate-energy piping, seismic requirements, and the impact of the failure of nonseismic Category I SSCs.

C.I.9.5.5.4 ***Inspection and Testing Requirements***

The applicant should describe the inspection and testing procedures for the diesel generator cooling water system.

C.I.9.5.6 ***Diesel Generator Starting Air System***

C.I.9.5.6.1 ***Design Bases***

The applicant should provide the design bases for the diesel generator starting air system, including the required system capacity and the implications of shared systems, if any, on the system's capability to perform its function.

C.I.9.5.6.2 ***System Description***

The applicant should provide a description and drawings of the diesel generator starting air system, including designation of essential portions of the system and their location. The applicant should provide descriptions of instrumentation, control, testing, and inspection features as well as applicable inspection and testing procedures for the diesel generator starting air system.

C.I.9.5.6.3 ***Safety Evaluation***

The applicant should provide an evaluation of the diesel generator starting air system, including consideration, as applicable, of internally or externally generated missiles, forces from piping cracks/breaks in high- and moderate-energy piping, the impact of the failure of nonseismic Category I SSC, and the ability to meet independence and redundancy requirements of onsite electric power supplies assuming a single failure. Discuss, if applicable, the system's capability to perform its function in the event of a SBO.

C.I.9.5.7 *Diesel Generator Lubrication System*

C.I.9.5.7.1 ***Design Basis***

The applicant should provide the design bases for the diesel generator lubrication system, including the following considerations:

- internally or externally generated missiles and forces from crankcase explosions
- the impact of the failure of nonseismic Category I SSC
- functional capability during high water levels (i.e., flooding, if applicable)
- capability to detect and control/isolate system leakage
- provision of instrumentation and testing systems
- provisions to ensure that normal protective interlocks do not preclude engine operation during emergency conditions, if applicable
- provisions for cooling the system and removing system heat load
- adequacy of the lubrication system to perform its function in the event of a SBO, if applicable
- system design for prevention of dry starting (momentary lack of lubrication)

C.I.9.5.7.2 ***System Description***

The applicant should provide a description and drawings of the lubrication system, including measures taken to ensure the quality of the lubricating oil.

C.I.9.5.7.3 ***Safety Evaluation***

Provide an evaluation of the diesel generator lubrication system, including consideration, as applicable, of internally or externally generated missiles, forces from piping cracks/breaks in high- and moderate- energy piping, and the impact of the failure of non-seismic Category I SSCs. Discuss, if applicable, the system's capability to perform its function in the event of a SBO.

C.I.9.5.8 *Diesel Generator Combustion Air Intake and Exhaust System*

C.I.9.5.8.1 ***Design Bases***

The applicant should provide the design bases for the diesel generator combustion air intake and exhaust system, including the bases for protection from the effects of natural phenomena, missiles, and contaminating substances, as related to the facility site, systems, and equipment, as well as the system's capability to meet minimum applicable safety requirements assuming a single failure. Address the potential for a single active failure to lead to the loss of more than one diesel generator system. This section should reference the seismic and quality group classifications provided in FSAR Section 3.2. Discuss the adequacy of the combustion air intake and exhaust system to perform its function in the event of a SBO, if applicable.

C.I.9.5.8.2 *System Description*

The applicant should provide a complete description of the system, including system drawings detailing component redundancy, where required, and showing the location of system equipment in the facility and the relationship to site systems or components that could affect the system.

C.I.9.5.8.3 *Safety Evaluation*

The applicant should provide analyses to address the minimum quantity and oxygen content requirements for intake combustion air. Also provide the results of failure modes and effects analyses to ensure that the system meets the applicable minimum requirements and the ability to meet independence and redundancy requirements of onsite electric power supplies assuming a single failure. Address system degradation, if any, that could result from the consequences of missiles or failures of high- or moderate-energy piping systems located in the vicinity of the combustion air intake and exhaust system, and any impact on the system's minimum safety functional requirements.

C.I.9.5.8.4 *Inspection and Testing Requirements*

The applicant should describe inspection and periodic system testing requirements, features, and procedures for the diesel generator combustion air intake and exhaust system.