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Subject: **GE Response to Results of NRC Acceptance Review for ESBWR Design Certification Application – Items 8, 12, and 13 (TAC # MC8168)**

In the Reference 1 letter, the NRC indicated that additional information was required in certain areas of the ESBWR design certification application before the NRC could begin its review in those areas. Enclosure 1 contains additional information in the areas of flood protection, radiation protection, and fire protection. The format of this information is a close representation of how the information will appear in the DCD Rev. 01 and any additional changes will be identified. The numbering below corresponds to the Reference 1 attachment:

(8) Flood Protection

- Section 3.4, "Water Level (Flood) Design," has been entirely revised to include sufficient information for the staff to evaluate the ESBWR's protection from internal flooding. Changes to Section 3.4 are identified by change bars in the right margin.

(12) Radiation Protection

- Subsection 14.3.3.4 has been revised to delete any implication that a design acceptance criteria (DAC) would be used to complete and verify the adequacy of shielding design. Tier 1 Section 3.4 has been revised to indicate that radiation protection will be confirmed by an ITAAC during plant construction. Tier 1

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Section 3.4, Table 3.4-1, Table 3.4-3 and Figures 3.4-1 through 3.4-22 have been deleted. (These changes are not identified by a change bar.)

- DCD Section 12.6, "Minimization of Contamination and Radwaste Generation," (a new stand alone Section) has been developed to address the NRC's request to summarize how the ESBWR meets the requirements of 10 CFR 20.1406.

(13) Fire Protection

- DCD Tables 1.9-9, 1.11-1, and 3.2-1, subsection 9A.2.1 and subsection 9.5.1.12, "Safety Evaluation," have been revised to address the NRC's acceptance issues in the Fire Protection Area. Revisions to this section are marked with a bar in the right hand column.
- GE believes that the safe shutdown criteria questioned by the staff is addressed in ESBWR DCD Appendix 9A. The evaluation of the post-fire safe shutdown for ESBWR per NFPA 804 criteria (more conservative than Reg. Guide 1.189 criteria) is summarized in DCD Section 9A.4 and covered in more detail for each fire area in the lower right corner of DCD Tables 9A.5-1 through 9A.5-7.

If you have any questions about the information provided here, please let me know.

Sincerely,

KLClipton for

David H. Hinds
Manager, ESBWR

Reference:

1. MFN 05-103, Letter from U. S. Nuclear Regulatory Commission, to Steven A. Hucik, *Results of Acceptance Review for ESBWR Design Certification Application (TAC NO. MC8168),* September 23, 2005

Enclosure:

1. MFN 05-108 – GE Response to Results of NRC Acceptance Review for ESBWR Design Certification Application – Flood Protection, Radiation Protection, Fire Protection

MFN 05-108

cc: WD Beckner USNRC (w/o enclosures)
AE Cubbage USNRC (with enclosures)
LA Dudes USNRC (w/o enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRF 0000-0046-6905
eDRF 0000-0040-9476

ENCLOSURE 1

MFN 05-108

GE Response to Results of NRC Acceptance Review for ESBWR Design Certification Application

Flood Protection

Radiation Protection

Fire Protection

3.4 WATER LEVEL (FLOOD) DESIGN

Design of the plant flood protection includes all structures, systems and components whose failure could prevent safe shutdown of the plant or result in uncontrolled release of significant radioactivity to assure conformance with the requirements of General Design Criterion 2.

3.4.1 Flood Protection

As discussed in SRP 3.4.1, this section describes the plant flood protection for all structures, systems and components (SSC) whose failure could prevent safe shutdown of the plant or result in uncontrolled release of significant radioactivity to assure conformance with the requirements of General Design Criterion 2. The analysis identifies the safety-related SSC that must be protected against flooding from both external and internal causes to: demonstrate the capabilities of structures housing safety-related systems or equipment to withstand flood considerations, i.e., the relationship between structure elevation and flood elevation including waves and wind effects as described in Subsections 2.4.2 through 2.4.7; assess the adequacy of the isolation of redundant safety-related systems or equipment subject to flooding, including possible inleakage sources, such as cracks in structures not designed to withstand seismic events and exterior or access openings or penetrations in structures located at a lower elevation than the flood level and associated wave activity. The analysis also includes consideration of flooding from internal sources of safety-related SSC from failure of tanks, vessels, and piping. The effects of piping failures are considered in Section 3.6.

The flood protection measures meet specific general design criteria and regulatory guides. The plant design for protection of SSC from the effects of flooding considers the relevant requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and 10 CFR Part 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," Section IV.C as related to protecting safety-related SSC from the effects of floods, tsunamis and seiches. The design meets the guidelines of Regulatory Guide 1.59 with regard to the methods utilized for establishing the probable maximum flood (PMF), probable maximum precipitation (PMP), seiche and other pertinent hydrologic considerations; and the guidelines of Regulatory Guide 1.102 regarding the means utilized for protection of safety-related SSC from the effects of the PMF and PMP. If safety-related structures need to be protected from below-grade groundwater seepage by means of a permanent dewatering system, then the system is designed as a safety-related system and meets the single failure criterion requirements. The ESBWR permanent dewatering system is non-safety related. The design criteria for protection against the effects of compartment flooding meet ANSI/ANS56.11, "Design Criteria for Protection Against the Effects of Compartment Flooding in Light Water Reactor Plants". This subsection discusses the flood protection design and operational measures that are applicable to the plant Seismic Category I SSC and addresses both external flooding and postulated internal flooding from plant piping failures, fire fighting, and other sources.

3.4.1.1 Flood Protection Summary

The safety-related systems and components of the ESBWR standard plant are located in the Seismic Category I structures that provide protection against external flood and groundwater damage. External flood design considerations for safety-related systems and components are provided for the postulated flood and groundwater levels and conditions described in Section 2.4 and Table 3.4-1.

The Seismic Category I structures that house safety-related systems and equipment and that offer flood protection are described in Section 3.8. All exterior access openings are above flood level and exterior penetrations below design flood and groundwater levels are appropriately sealed.

The internal flood analysis evaluates whether a single pipe failure, a fire fighting event or other flooding source, as described in Subsection 3.4.1.4, could prevent safe reactor shutdown. The floor drain piping system limits water accumulation in compartments with possible flooding. In all cases system components are located above the flood level or are capable of operating flooded. Appropriate means are provided to prevent flooding compartments that house redundant system trains or divisions. Some of the mechanisms used to minimize flooding are structural barriers or compartments; curbs and elevated thresholds, at least 200 mm (8 in) high; and a leak detection system. See Subsection 3.4.1.3 for further discussion.

3.4.1.2 Flood Protection From External Sources

Safety-related systems and components are protected from exterior sources (e.g., floods, groundwater) because they are located above design flood level or because they are enclosed in groundwater protected concrete structures.

The Seismic Category I structures that may be subjected to the design basis flood are designed to withstand the flood level and groundwater level stated in Section 2.4. This is done by locating the plant grade elevation above the flood level and by incorporating structural provisions into the plant design to protect the structures, systems and components from the postulated flood and groundwater conditions.

This approach provides:

- Wall thicknesses below flood level that are designed to withstand hydrostatic loads because the permanent dewatering system is non-safety related.
- Water stops provided in all expansion and construction joints below flood and groundwater levels.
- Waterproof coating of below flood and groundwater levels external surfaces.
- Water seals at pipe penetrations below flood and groundwater levels.
- Roofs designed to prevent pooling of large amounts of water in accordance with Regulatory Guide 1.102.

The flood protection measures that are described above are not only for external natural floods but also guard against flooding from on-site storage tank rupture. Such tanks are designed and constructed to minimize the risk of catastrophic failure and are located to allow drainage without damage to site facilities.

The typically relatively long time available as a flood condition develops allows ample time to take appropriate measures to assure all facility flood protection measures are in place. Because plant grade is above design flood level the Seismic Category I structures remain accessible during postulated flood events (See Table 3.4-1).

3.4.1.3 Internal Flooding Evaluation Criteria

All safety-related components that affect the safe shutdown of the plant are located in the Reactor Building (RB) and Control Building (CB). Redundant systems and components are physically separated from each other and from non-safety systems. If the failure of a system results in one division being inoperable, the redundant division is available to perform the safe shutdown of the plant. Protective features used to mitigate or eliminate the consequences of internal flooding are:

- Structural enclosures or barriers
- Curbs and sills
- Leakage detection components
- Drainage systems

The internal flooding analysis, besides identifying flooding sources, equipment in each area, and effect on essential equipment and maximum flood levels, also considers the following criteria:

- Time to identify a flooding source when a flooding alarm occurs in the Main Control Room is followed by operator action within 30 minutes.
- Fire fighting events are considered assuming that fuel inventory for the fire is limited to a 1-hour event, during which two 7.9 l/s (125 gpm) fire hoses are in service.
- A single active failure of flood mitigating systems is assumed, following the initiating events, as required in ANSI/ANS 56.11.
- No credit is taken for operation of the drain sump pumps, although they are expected to operate during some of the postulated flooding events.
- The free surface considered in each flooding zone is reduced by at least 10% due to space utilization by components located in that zone.

As established in Section 3.6, the moderate energy piping leakage failure is assumed to be a circular opening with a flow area of equal to one-half of the outside pipe diameter multiplied by one-half of the pipe nominal wall thickness. Resulting leakage flow rates are calculated using normal operating pressure in the pipe.

The Fire Protection System (FPS) headers from the FPS pumps are routed outside Seismic Category I buildings. Floors are assumed to prevent water seepage to lower levels.

Exposure to water spray shall be evaluated by the COL applicant. Spray damage is avoided by moving the required equipment or pipe or providing spray protection. Doors and penetrations rated as 3 hour barriers are assumed to prevent water spray from crossing divisional boundaries.

All safety-related equipment within the Containment that must operate during or after a design basis accident is qualified for LOCA environmental conditions. Flooding associated with the postulated failure of any moderate energy pipe is within the bounds of the LOCA qualification. Consequently, no detailed evaluation of this less severe event is required to verify the safe plant shutdown capability as a result of moderate energy piping failures in the Containment.

3.4.1.4 Evaluation of Internal Flooding

Leakage from pipe breaks and cracks, fire hose discharges and other flooding sources are collected by the floor drainage system, stair towers and elevator shafts and discharged to appropriate sumps. The drain system and other drainage paths limit water level in any flooded compartment to less than the difference between the finished room floor elevation and the flood level.

The RB and CB drain collection system and sumps are designed and separated so that drainage from a flooded compartment containing equipment for a train or division does not flow to compartments containing equipment for another system train or division. Zones that are isolated by watertight doors provide physical separation. The location of the zones prevents two redundant trains from being affected by the flooding at the same time.

The following flooding sources are considered in the analysis:

- High energy piping breaks and cracks
- Moderate energy piping, through-wall cracks
- Pump mechanical seal failures
- Storage tank ruptures
- Actuation of the FPS
- Flow from upper elevations and nearby areas

Through-wall cracks are considered in seismically supported, moderate energy piping as well as breaks and through-wall cracks in non-seismically supported moderate energy piping in the flooding analysis.

The analysis is performed based on the criteria and assumptions provided in Section 3.6 and ANS-56.11. Section 3.6 provides the criteria used to define break and crack locations and configurations for high and moderate-energy piping failures. Additional design criteria pertaining to the internal flooding analysis are provided in this section.

No breaks are assumed for piping with nominal diameters of 1 inch or less. For flooding analysis, in case of storage tank rupture, it is assumed that the entire tank inventory is drained.

Additional provisions for internal flood protection include administrative procedures to assure routine removal of debris, which might plug the floor drain openings.

Equipment necessary for safe shutdown is located above the maximum flood height or is qualified for flood conditions. Accordingly, flooding due to moderate energy pipe failure, or fire fighting or other flooding sources does not affect the ability to safely shut down the plant.

3.4.1.4.1 Control Building

There are no tanks or high-energy piping in the CB and the more relevant moderate-energy fluid system piping, i.e. Fire Protection System (FPS) and Chilled Water System (CWS), is seismically qualified. The main source of floodwater is from the fire protection standpipe hose stations. A nominal volume of 57 m3 (15,000 gal) is provided for the FPS considering two 7.9 l/s (125 gpm) fire hoses are in service for one (1) hour. This results in a flooding elevation in the lowest floor of the CB of 40 cm (16 in) in the corridors, stair towers and elevator rooms, assuming that the water propagates into these rooms by flowing through embedded drains and under the doors. This maximum water depth is below the DCIS room floor elevation.

To prevent greater flooding in the lower elevation of the CB from pipe failures in the HVAC rooms, the water is retained in the HVAC rooms by the installation of 200 mm (8 in.) high curbs in the access doors, chases and other floor openings, as well as by normally closed isolation valves in the drain lines.

In addition, for further protection, the DCIS room access doors are watertight. Normally closed valves are installed in the drain pipes of the DCIS rooms. Moreover, the access doors from the access tunnel to the CB at El.-2000 is watertight.

Therefore, the separation of electrical trains in independent zones, along with measures to direct the water to safe drain areas, maintains the safety function of the systems housed in the CB.

There is no flooding hazard in the Main Control Room.

3.4.1.4.2 Reactor Building

The potential sources of water in the Reactor Building include the Reactor Component Cooling Water System (RCCWS); Chilled Water System (CWS); Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) system; Control Rod Drive (CRD) system, including the CRD pump suction from the Condensate Storage and Transfer System (CS&TS) and Condensate and Feedwater System (C&FS); Fire Protection System (FPS); Fuel Auxiliary Pool Cooling System (FAPCS); Hot Water System (HWS); Makeup Water System (MWS); and Standby Liquid Control System (SLCS).

The large number of pools in the ESBWR is contained within thick concrete walls designed for maximum hydrostatic loads combined with seismically induced hydrodynamic loads. GDCS pools inside containment are similarly contained within substantial structural members designed for hydrostatic combined with seismically induced hydrodynamic events. These pools are not considered as potential sources of flood.

The piping of the RCCWS, CWS, CRD pump suction (CS&TS/C&FS), MWS, and FPS is seismically analyzed. These are moderate energy fluid systems and therefore only through-wall pipe cracks are considered.

The maximum flooding volume expected is from a through-wall pipe crack in the FPS or in the FAPCS suction lines from the suppression pool. The flooding volume from either of these sources is greater than flooding due to any failure in high and moderate energy piping or tanks.

The maximum volume of the suppression pool for flooding is limited to the difference between the maximum level and the anti-siphoning provision in the suction line elevation.

This results in a flood level of 20 cm (8 in) in the RB lower elevation. This maximum flood level is lower than the CRD Hydraulic Control Unit (HCU) room elevation. Other safety-related components in the lower elevation are located above the maximum flood level. Therefore, no flood in this RB elevation could affect the plant's safe shutdown capacity.

For further protection, the HCU room access doors and the access doors to the RB at El.-1000 are watertight.

The SLCS accumulators for Division 1 and 2 are located in fully independent rooms in El. 17500 of the RB. Therefore, SLCS high energy pipe break or tank failure flooding of one Division cannot affect the other.

Flooding in the electrical rooms is limited to the actuation of the fire protection system. The separation of the electrical trains in independent zones, along with measures to direct the water to safe drain areas, maintain the safety function of the systems housed in the RB.

The main steam tunnel contains the main steam and main feedwater piping and their isolation valves. In the event of a feedwater pipe break or leak in the main steam tunnel, water is drained to the Turbine Building. The safety-related components in the main steam tunnel are located above the maximum flood level or are designed to function when flooded.

3.4.1.4.3 Adjacent Flooding Events

- **Turbine Building.** – There are no components in the Turbine Building (TB) that could affect the safe shutdown of the reactor.

  The TB is subject to flooding from a variety of potential sources including the Circulating Water System (CIRC), Condensate and Feedwater System (C&FS), Plant Service Water System (PSWS), Reactor Component Cooling Water System (RCCWS), Turbine Component Cooling Water System (TCCWS), CWS and FPS.

  The bounding flooding source for the TB is a CIRC pipe or expansion joint failure. Level switches are located in the TB to limit flooding in the TB in the event of a failure in the CIRC (see Subsection 10.4.5.6). In any case, flooding in the TB could not affect the RB or CB because a 1.5 m high flooding barrier is provided in the access tunnel to the RB and CB (see Figure 1.2-13). A hypothetical massive flooding in the TB would run out of the building to the yard through relief panels.

- **Fuel Building** – There are no safety-related components in the Fuel Building (FB). The FPS, CWS, RCCWS, HWS, FAPCS, MWS and CS&TS (Condensate Storage Tank) are the primary sources of flooding in the FB. In any case, flooding in the Fuel Building could not affect the RB because the connection points in the lower elevation are watertight.

- **Radwaste Building** – The Radwaste Building (RW) does not contain safety-related equipment. The radwaste tunnel and other connections with the CB and RB are designed to prevent flooding from spreading in the RW to CB or RB. The primary sources of flooding in the RW are the Liquid Waste Management System (LWMS), the building drain systems, RWCU/SDC, FAPCS, Condensate Purification System (CPS), CS&TS, CWS, HWS and FPS. In case of flooding the building substructure serves as a large sump which can collect and hold any leakage within the building.

- **Electrical Building** – There are no safety-related components in the Electrical Building (EB). The flooding water in a non safety-related diesel generator room is discharged outside via the equipment access door.

  The primary sources of flooding in the EB are the FPS, CWS, HWS and RCCWS (non-safety related diesel generator rooms). The main source of floodwater is due to an FPS piping failure. A flooding barrier is provided at the Nuclear Island (NI) access tunnel EB access door. In any case, flooding in the EB could not affect the RB or CB because the access doors to the CB and RB are watertight.

3.4.2 Analysis Procedures

In accordance with SRP 3.4.2, the following paragraphs describe the design of seismic Category I structures to withstand the effects of the external flood or highest ground water specified for the plant. The design parameters of the flood or highest groundwater are considered from the standpoint of use in defining the input parameters for the structural design criteria appropriate to account for flood and groundwater loadings. Since the ESBWR plant is located at sites where the flood level is less than the plant grade around the structures, the dynamic phenomena associated with such a flooding such as currents, wind waves, and their hydrodynamic effects, is not considered. The bases for these parameters are discussed in Subsection 2.4.2. The procedures that are utilized to transform the static and dynamic effects of the flood and highest groundwater into effective loads applied to seismic Category I structures are discussed in this subsection.

The design of ESBWR structures complies with the relevant requirements of GDC 2 concerning natural phenomena. The envelope of site parameters used in the design of Seismic Category I structures meets the following characteristics:

1. The flood or highest groundwater and dynamic effects, if any, used in the design are the most severe ones that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.
2. The flood or highest ground water level for the plant is below the finished ground level as shown in Table 3.4-1.
3. The flood level of the plant is below the plant grade and only the hydrostatic effects need to be considered. The hydrostatic head associated with the flood or with the highest groundwater level is considered as a structural load on the basemat and basement walls. Uplift or floating of the structure is considered and the total buoyancy force is based on the flood or highest groundwater head excluding wave action. However, the lateral, overturning and upward hydrostatic pressures acting on the side walls and on the foundation slab, respectively, are considered in the structural design of these elements and are based on total head.

Because the design flood elevation is below the finished plant grade (Table 3.4-1), there are no dynamic forces due to flood. The lateral hydrostatic pressures on the structures due to the design flood level, as well as ground water and soil pressure, are factored into the structural design in accordance with SRP 3.4.2.

3.4.3 COL Information

3.4.3.1 Detailed flooding in zones prone to internal flooding due to water spray shall be evaluated by the COL applicant.

3.4.4 References

None.

Table 3.4-1

Structures, Penetrations and Access Openings Designed for Flood Protection

	Reactor & Fuel Buildings	Control Building
Top of Basemat (mm)	El. -11500	El. -7400
Design Groundwater Level (mm)	El. 4040	El. 4040
Design Flood Level (mm)	El. 4340	El. 4340
Reference Plant Grade (mm)	El. 4650	El. 4650
Actual Plant Grade (mm)*	Site Specific	Site Specific
Building Elevation (mm)	El. 52400	El. 13500
Penetrations Below Design Flood Level	Sealed	Sealed
Access Openings Below Design Flood Level	None	None (except at CB access to RB at tunnel)

* The finished plant grade is at least 0.31 meters (1 foot) above the design flood elevation.

- The fundamental design work for the ESBWR HSI has been completed and is described in Tier 2. This includes commitments to a set of standard design features as well as a minimum inventory of fixed alarms, displays and controls necessary for the operators to implement the emergency operating procedures and to carry out those human actions shown to be important by the plant PRA. This design information, coupled with the comprehensive commitments to HSI implementation processes based on currently accepted HFE practices, provides confidence that the execution of these processes result in acceptable MCR and RSS detail designs that implement the applicable requirements.

Selection of specific technical material for the HFE design descriptions and ITAAC entries in the Tier 1 utilized the same selection criteria and methodology as described above for Tier 1, Section 2 system entries.

14.3.3.4 Radiation Protection

The radiation protection section (Chapter 12) of Tier 2 defines the design confirming that radiation protection features maintain exposures for both plant personnel and the general public below allowable limits. The material applies to the radiological shielding and ventilation design of buildings within the scope of the ESBWR certified design. Confirmation that the building shield wall and floor thickness are in accordance with the radiation shielding calculations will be included in the building inspection ITAAC.

14.3.3.5 Initial Test Program

The Initial Test Program (ITP) defines testing activities that are conducted following completion of construction and construction-related inspections and tests. The ITP extends through to the start of commercial operation of the facility. This program is discussed within Section 14.2 and centers heavily on testing of the safety-related systems.

A summary of the ITP has been included in Tier 1, Section 3.5. This summary includes an overview of the ITP structure together with commitments related to test documentation and administration controls. This information has been included in Tier 1 because of the importance of the ITP in defining comprehensive pre- and post-fuel load testing for the as-built facility to demonstrate compliance with the design certification. Key pre-fuel load ITP testing for individual systems is defined in the system ITAAC in Tier 1, Sections 2 and 3.

No ITAAC entries have been included in Tier 1 for the ITP. This is acceptable because:

- Many of the ITP activities involve testing with the reactor at various power levels and thus cannot be completed prior to fuel load (Part 52 requires ITAAC to be completed prior to fuel load).
- Testing activities specified as part of the ITAAC in Tier 1, Sections 2 and 3 must be performed prior to fuel load. Because these ITAAC testing activities address the design features and characteristics of key safety significance, additional ITAAC for the ITP as defined in Tier 1, Section 3.5 are not necessary to assure that the as-built plant conforms with the ESBWR certified design.

The post-accident radiation zone maps for the areas in the Reactor Building have been developed. These zone maps represent the maximum gamma dose rates that exist in these areas during the post-accident period.

Inspections, Tests, Analyses and Acceptance Criteria

Table 3.4-1 provides definitions of the inspections, test and/or analyses, together with associated acceptance criteria, which will be undertaken for ventilation and airborne monitoring.

Table 3.4-1

ITAAC For Ventilation and Airborne Monitoring

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Plant design provides for containment of airborne radioactive materials, and the ventilation system ensures that concentrations of airborne radionuclides are maintained at levels consistent with personnel access needs.	1. Expected concentrations of airborne radioactive material will be calculated by radionuclide for normal plant operations, anticipated operational occurrences for each equipment cubicle, corridor, and operating area requiring personnel access. Calculations will consider:	1. Calculation of radioactive airborne concentration demonstrates that:
	a. Design ventilation flow rates for each area.	a. For normally occupied rooms and areas of the plant (i.e., those areas requiring routine access to operate and maintain the plant) equilibrium concentrations of airborne radionuclide will be a small fraction of the occupational concentration limits listed in 10 CFR 20 Appendix B.
	b. Typical leakage characteristics for equipment located in each area, and	b. For rooms that require infrequent access (such as for non-routine equipment maintenance), the ventilation system is capable of reducing radioactive airborne concentrations to (and maintaining them at) the occupational concentration limits listed in 10 CFR 20 Appendix B during the periods that occupancy is required.
	c. A radiation source term in each fluid system will be determined based upon an assumed off gas rate of 3,700 MBq/second (30 minute decay) appropriately adjusted	c. For rooms that seldom require access, plant design provides containment and ventilation to reduce airborne contamination spread to other areas of

Table 3.4-1

ITAAC For Ventilation and Airborne Monitoring

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	for radiological decay and buildup of activated corrosion and wear products.	lower contamination.
2. Airborne radioactivity monitoring is provided for those normally occupied areas of the plant in which there exists a significant potential for airborne contamination. The airborne radioactivity system: a. Has the capability of detecting the time integrated concentrations of the most limiting internal dose particulate and iodine radionuclides in each area equivalent to the occupational concentration limits in 10 CFR 20, Appendix B for 10 hours. b. Provides local audible alarms (visual alarms in high noise areas) with variable alarm set points, and readout/annunciation capability.	2. An analysis of the as-built airborne radioactivity monitoring system will be performed.	2. Airborne radioactivity monitoring system is installed as defined in this certified design commitment.

12.6 MINIMIZATION OF CONTAMINATION AND RADWASTE GENERATION

This section discusses how the ESBWR design procedures for operation will minimize contamination of the facility and environment, facilitate decommissioning, and minimize the generation of radioactive waste, in compliance with 10 CFR 20.1406.

12.6.1 Minimization of Contamination to Facilitate Decommissioning

Examples of ESBWR design features that minimize contamination and facilitate decommissioning include the following:

- Design of equipment and pipe routing to minimize crud traps and the buildup of radioactive material and to facilitate flushing of crud traps.
- ESBWR is designed with systems that have the key function of maintaining plant water quality within specified limits. These systems include the Reactor Water Cleanup/Shutdown Cooling System, Fuel and Auxiliary Pools Cooling System and Condensate Purification System. These systems use deep bed filter demineralizers to minimize crud buildup in the plant water and to minimize solid radwaste generation from spent resin.
- ESBWR is designed with provisions for draining, flushing, and decontaminating equipment and piping.
- Penetrations through inner and outer walls of any building from rooms that contain radiation sources are required to be sealed to prevent miscellaneous leaks to the environment or radiation streaming.
- Equipment drain sump vents are piped directly to the radwaste HVAC system to remove airborne contaminants evolved from discharges to the sump.
- Appropriately sloped floor drains are provided in areas where the potential for a spill exists to limit the extent of contamination.
- Provisions for epoxy-type wall and floor coverings, which provide smooth surfaces to ease decontamination.
- Equipment and floor drain sumps are stainless steel lined to reduce crud buildup and to provide surfaces that can be easily decontaminated.
- For all areas potentially having airborne radioactivity, the ventilation systems are designed such that during normal and maintenance operations, airflow between areas is always from an area of low potential contamination to an area of higher potential contamination.
- The reactor building HVAC system is divided into three major subsystems: RB Contaminated Area HVAC, Refueling and Pool Area HVAC and the RB Clean Area HVAC. The RB Clean Area HVAC subsystem conditions and circulates air through all the clean areas of the reactor building; the RB Contaminated Area HVAC subsystem conditions and circulates air through the contaminated areas of the building and the Refueling and Pool Area HVAC subsystem services the RB Operating floor.

- The ESBWR is designed to limit the use of cobalt bearing materials on moving components that have historically been identified as major sources of in-water contamination.
- The ESBWR Radwaste System has been designed to recycle 100% of the liquid radwaste (i.e. zero liquid release) and to minimize solid waste volume. The Radwaste system minimizes all Class A, B, and C waste.
- All Radwaste collection tanks are located in an environmentally controlled structure and are designed for 1 to 2 years storage per tank for solid wet waste. The collection tank vaults are below grade and designed to hold the entire collection tank volume without leakage if the tank should rupture. All collection tanks are designed with conical bottoms with relatively steep slopes. This prevents the buildup of residual reactivity in the collection tanks and facilitates removal of accumulated solids during routine processing and decontamination. Collection tank bottom blowdown capability is provided for removing any residual sludge on a periodic basis.

12.6.2 Minimization of Radioactive Waste Generation

Examples of ESBWR design procedures for operations that minimize the generation of radioactive waste include the following:

- The Liquid Waste Management System (LWMS) is divided into several subsystems, so that the liquid wastes from various sources can be segregated and processed separately, based on the most efficient process for each specific type of impurity and chemical content. This segregation allows for efficient processing and minimization of overall liquid waste.
- During liquid processing by the LWMS, radioactive contaminants are removed and the bulk of the liquid is purified and either returned to the condensate storage tank or discharged to the environment, minimizing overall liquid waste. The radioactivity removed from the liquid waste is concentrated in filter media ion exchange resins and concentrated waste. The filter sludge, ion exchange resins and concentrated waste are sent to the Solid Waste Management System (SWMS) for further processing.
- The SWMS is designed to segregate and package the wet and dry types of radioactive solid waste for off-site shipment and burial. This segregation allows for efficient processing and minimization of overall solid waste.
- For management of gaseous radioactive waste, the Offgas System (OGS) minimizes and controls the release of radioactive material into the atmosphere by delaying release of the offgas process stream initially containing radioactive isotopes of krypton, xenon, iodine, nitrogen, and oxygen.

The LWMS, OGS, and SWMS are discussed and described in more detail in Sections 11.2, 11.3, and 11.4, respectively.

Table 1.9-9

Summary of Differences from SRP Section 9

SRP Section	Specific SRP Acceptance Criteria	Summary Description of Difference	Subsection Where Discussed
9.4.4		None	
9.4.5		The engineered safety features described in Chapter 6 do not require a separate ventilation system. This section is not applicable to ESBWR.	
9.5.1	Section 6.1.2 of Regulatory Guide 1.189 states in part: "Peripheral rooms in the control room complex should have automatic water suppression..."	The office spaces contained in the ESBWR Main Control Room Complex do not have automatic fire suppression systems installed.	9.5.1.12.1.2
	Section 6.1.2.1 of Reg Guide 1.189 states in part: "...Fully enclosed electrical raceways located in under-floor and ceiling spaces, if over 0.09 m^2 (1 sq ft) in cross-sectional area, should have automatic fire suppression inside."	ESBWR design does not include any fixed fire suppression system in the under-floor area	9.5.1.12.1.3
	Section 6.1.2.2 of Reg Guide 1.189 states in part: "Smoke detectors should be provided in the control room, cabinets, and consoles."	ESBWR consoles and electrical cabinets do not have fire detectors installed inside them.	9.5.1.12.1.1

Table 1.9-9

Summary of Differences from SRP Section 9

SRP Section	Specific SRP Acceptance Criteria	Summary Description of Difference	Subsection Where Discussed
	Section 6.1.4 of Regulatory Guide 1.189 states in part: "Computer rooms for computers performing functions important to safety that are not part of the control room complex should be separated from other areas of the plant by barriers having a minimum fire resistance rating of 3 hours and should be protected by automatic detection and fixed automatic suppression."	ESBWR design does not include any fixed fire suppression systems for safety-related computer rooms	9.5.1.12.1.6
	Section 6.1.8 of Regulatory Guide 1.189 states in part: Day tanks with total capacity up to 4164 L (1100 gallons) may be located in the diesel generator area under the following conditions: a. The day tank is located in a separate enclosure with fire resistance rating of at least 3 hours"	Based on the size of the nonsafety-related diesel generators, the capacity of each of the diesel day tanks will likely exceed 4164 L (1100 gallons) to allow enough fuel for at least 4 hours of diesel operation at the maximum load demand.	9.5.1.12.1.4

Table 1.9-9

Summary of Differences from SRP Section 9

SRP Section	Specific SRP Acceptance Criteria	Summary Description of Difference	Subsection Where Discussed
	Section 6.1.8 of Regulatory Guide 1.189 states in part: "Automatic fire suppression should be installed to suppress or control any diesel generator or lubricating oil fires. Such systems should be designed for operation when the diesel is running without affecting the diesel."	The automatic sprinkler systems in the diesel generator rooms are installed to extinguish any fire in those rooms and do not place restrictions on the positioning and direction of the application of the fire suppressant.	9.5.1.12.1.5
9.5.2		None	
9.5.3	Illuminating Engineering Society Lighting Handbook	None	N/A
9.5.4 VI	See VI REFERENCES apply to "Emergency Diesel Engine Fuel Oil and Transfer System ".	The Standard ESBWR DG and auxiliary systems are not safety-related and have no safety design basis.	9.5.4.1
9.5.5	See VI REFERENCES apply to "Emergency Diesel Engine Cooling Water System."	The Standard ESBWR DG and auxiliary systems are not safety-related and have no safety design basis.	9.5.5.1
9.5.6	See VI REFERENCES apply to "Emergency Diesel Engine Starting System".	The Standard ESBWR DG and auxiliary systems are not safety-related and have no safety design basis.	9.5.6.1
9.5.7	See VI REFERENCES apply to "Emergency Diesel Engine Lubrication System".	The Standard ESBWR DG and auxiliary systems are not safety-related and have no safety design basis.	9.5.7.1
9.5.8	See VI REFERENCES apply to "Emergency Diesel Engine	The Standard ESBWR DG and auxiliary systems are not safety-related and have no safety design	9.5.8.1

Table 1.11-1 (continued)

Action Plan Item/Issue Number	Description	Associated Tier 2 Location(s) and/or Technical Resolution
Issue 53	Consequences of a Postulated Flow Blockage Incident in a BWR	(3)
Issue 54	Survey of Valve Operator-Related Events Occurring During 1978, 1979, and 1980	(8) Appendix 1A, II.E.6.1
Issue 55	Failure of Class 1E Safety-Related Switchgear Circuit Breakers to Close on Demand	(3)
Issue 56	Abnormal Transient Operating Guidelines as Applied to a Steam Generator Overfill Event	(1)
Issue 57	Effects of Fire Protection System Actuation on Safety-Related Equipment	(6) The ESBWR Fire Protection System (FPS) described in Subsection 9.5.1 is designed in compliance with NUREG-0800, SRP 9.5.1 Branch Technical Position (BTP) SPLB 9.5-1. Therefore, this issue is resolved for the ESBWR Standard Plant design. Refer to Subsection 9.5.1 for further details.
Issue 58	Containment Flooding	(3)
Issue 59	Technical Specification Requirements for Plant Shutdown When Equipment for Safe Shutdown Is Degraded or Inoperable	(5)

Table 3.2-1

Classification Summary

Principal Components[1]	Safety Design.[2]	Location[3]	Quality Group[4]	QA Req.[5]	Seismic Category[6]	Notes
U42 Potable Water and Sanitary Waste System	N	CB, SB, EB, RB, OO	—	E	NS	
U43 Fire Protection System (FPS)						
1. Non-seismic yard piping loop and valves including supports	N	OO, OL	D	E	NS	**Fire Protection System** — A quality assurance program meeting the guidance of NRC Branch Technical Position SPLB 9.5-1 (NUREG-0800) is applied to the protection system. Also, special seismic qualification requirements are applied.
2. Seismic category I piping loop and valves including supports	N	OO, RB, CB, FB	D	E	I	Same as above.
3. Fire water storage tank	N	OO	D	E	I	Same as above.
4. Fire pump enclosure	N	OO	—	E	NS	Same as above.
5. Seismic category I pump including diesel-engine drive	N	OO	D	E	I	Same as above.
6. Booster pumps	N	RB	D	E	I	Same as above.
7. Motors for seismic category I pumps	N	OO,RB	—	E	I	Same as above.
8. Other pumps and motors	N	OO	D	E	NS	Same as above.
9. Electrical modules and cables for RB preaction sprinklers	N	RB	—	E	I	Same as above.
10. All other electrical modules and cables	N	ALL	—	E	NS	Same as above.
11. CO_2 actuation modules	N	TB	—	E	NS	Same as above.
12. Sprinklers	N	RB, TB, RW, SB, EB, OL	D	E	NS	Same as above.

The EB HVAC System provides smoke removal for the Electrical Building. The smoke removal mode of the EB HVAC System provides smoke removal from the diesel generator engine rooms and diesel generator day tank rooms.

Turbine Building (TB) Smoke Removal

The TB HVAC System provides smoke removal for the Turbine Building. A fire in the Turbine Building is annunciated in the MCR. Fire dampers in the supply and exhaust ducts close to preclude the spread of a Turbine Building fire to other areas. Following fire suppression in the Turbine Building, fire dampers are opened as appropriate for smoke removal. The smoke removal mode of the TB HVAC System provides smoke removal from the Turbine Building areas. Turbine Building Exhaust (TBE) fans can be operated to expedite smoke removal as described in Subsection 9.4.4.

9.5.1.12 Safety Evaluation

The FHA, contained in Appendix 9A, demonstrates the adequacy of the ESBWR fire protection design to provide the required protection in the event of a postulated fire.

The methodology for performing the FHA consistent with the level of ESBWR design completion is described in the FHA.

The FHA includes the following information:

- Fire Protection System description;
- Comparison of the ESBWR Fire Protection Program with NRC Branch Technical Position SPLB 9.5-1, demonstrating conformance of the ESBWR program and design with the guidance in the Branch Technical Position;
- Methodology for evaluation of potential fire hazards; and
- Safe shutdown analyses on a fire area by fire area basis.

Included in the above are complete descriptions of the fire areas, fire loadings in the areas, and fire detection and suppression capabilities provided in each area.

The COL licensee referencing the ESBWR Standard Plant conducts a compliance review of the as-built design against the assumptions and requirements stated in the FHA. Based on this review, the FHA is updated as necessary.

The ESBWR design satisfies the following guidance from the NUREG-0800 SRP 9.5.1 and BTP SPLB 9.5-1:

Guidance — "Therefore, the designers of standard plants have been informed that they must demonstrate that safe shutdown of their designs can be achieved, assuming that all equipment in any one fire area has been rendered inoperable by fire and that reentry to the fire area for repairs and for operator actions is not possible. The control room should be excluded from this approach, subject to the need for an independent alternate shutdown capability that is physically and electrically independent of the control room."

Conformance — The design of the fire barrier system and safe shutdown systems for the ESBWR are such that complete burnout of any single fire area without recovery does not prevent safe shutdown of the plant.

{INSERT for 9.5.1.12 Safety Evaluation}

9.5.1.12.1 Design Exceptions

The ESBWR fire protection design follows the recommendations of BTP SPLB 9.5-1 or Regulatory Guide 1.189 with the following exceptions:

9.5.1.12.1.1 No Fire Detection within Electrical Cabinets in Main Control Room Complex

Section C.7.1.4 of BTP SPLB 9.5-1 recommends that electrical cabinets should be protected as described in Regulatory Guide 1.189. Section 6.1.2.2 of Regulatory Guide 1.189 states in part:

"Smoke detectors should be provided in the control room, cabinets, and consoles."

ESBWR consoles and electrical cabinets do not have fire detectors installed inside them.

Justification: The electrical cabinets and consoles contain limited combustibles and are air-cooled so that smoke from an interior fire will exhaust to the room. Early warning fire detection, primarily consisting of ionization smoke detectors, is provided in all rooms containing consoles or electrical cabinets. A fire in any single cabinet or console will not disable the capability to safely shut down the plant. Except in the Main Control Room Complex, all safety-related electrical cabinets and consoles are located in divisional rooms, and all divisional rooms are separated from each other by 3 hour fire-rated barriers such that a single fire will not affect electrical cabinets or consoles from multiple divisions. The Main Control Room Complex is continuously manned so that any fire will be quickly detected and manual fire suppression activities would be initiated quickly upon discovery of a fire. In the unlikely event that a fire in the Main Control Room were to require evacuation, use of either the Division I or Division II Remote Shutdown Panels (located remotely from Main Control Room, in the Reactor Building) enable the operators to bring the reactor to a safe shutdown.

9.5.1.12.1.2 No Automatic Fire Suppression in Office Areas of Main Control Room Complex

Section C.8.1.2.c of BTP SPLB 9.5-1 recommends that automatic suppression capability should be provided in the Control Room Complex as described in Regulatory Guide 1.189. Section 6.1.2 of Regulatory Guide 1.189 states in part:

"Peripheral rooms in the control room complex should have automatic water suppression..."

The office spaces contained in the ESBWR Main Control Room Complex do not have automatic fire suppression systems installed.

Justification: The Main Control Room Complex is considered to be a low risk fire area, due to the lack of high- or medium-voltage equipment or cabling. Interior finishing materials within the Main Control Room Complex are noncombustible or have a flame spread and smoke developed rating of 25 or less. The amount of transient combustibles within this fire area is limited. Papers within the Main Control Room Complex are stored in file cabinets, bookcases, or other storage locations except when in use. Ionization or photoelectric smoke detectors are installed throughout the Main Control Room Complex to provide early warning of fire during the incipient stage. The Main Control Room Complex is continuously manned so that any fire will be quickly detected and manual fire suppression activities would be initiated quickly upon discovery of a fire. Should manual fire fighting in the Main Control Room Complex be necessary using either portable fire extinguishers or hand held fire hoses, accumulation or drainage of fire water will not affect the ability to safely shutdown the reactor. If the fire water is assumed to transport immediately to the basement of the Control Building, the resulting accumulation of water will not affect safety-related equipment located in the basement. In either case, the fire fighting activities will not prevent the reactor from being safely shutdown.

Finally, in the unlikely event that a fire in the Main Control Room were to require evacuation, use of either the Division I or Division II Remote Shutdown Panels (located remotely from Main Control Room, in the Reactor Building) enable the operators to bring the reactor to a safe shutdown.

9.5.1.12.1.3 No Automatic Fire Suppression Below Raised Floor in Main Control Room Complex

Section C.8.1.2.c of BTP SPLB 9.5-1 recommends cable raceways under raised floors should be reviewed to determine if adequate fire detection and suppression are provided for potential fires in these areas. Section 6.1.2.1 of Regulatory Guide 1.189 states in part:

"...Fully enclosed electrical raceways located in under-floor and ceiling spaces, if over 0.09 m2 (1 sq ft) in cross-sectional area, should have automatic fire suppression inside."

The Main Control Room Complex has a raised floor over a subfloor volume which is used for routing of cables between the electrical cabinets, control panels, computer equipment, and the divisional electrical rooms. Divisional separation of the subfloor cabling is maintained per the requirements of IEEE 384. The subfloor volume includes full fire detection but does not include any automatic fire suppression system.

Justification: The Main Control Room Complex and subfloor volume is considered to be a low risk fire area, due to the lack of high- or medium-voltage equipment or cabling. The characteristics of the subfloor cables are such that the probability of a fire ignition is very low and any fire that were to occur would be self-extinguishing or very slow to spread.

There are no transient combustibles stored in the subfloor volume during normal activities. Ionization smoke detectors are installed throughout the subfloor volume to provide early warning of fire during the incipient stage. The raised floor consists of noncombustible sectional panels that can be individually removed to provide fire-fighting access to a subfloor fire. Because the Control Room is continuously manned, manual fire suppression activities would be initiated quickly upon discovery of a fire in the subfloor volume. Since fire resistant cables are used, the amount of water needed to extinguish a fire within the subfloor volume is relatively small. Any water that is introduced into the subfloor volume can be removed by floor drains in the subfloor volume or through the use of temporary portable sump pumps. Accumulation of water in the subfloor volume is limited in depth to less than the raised floor height and will not adversely effect water sensitive safety-related equipment which is installed above the raised floor. Effectiveness of a permanently installed fire suppression system within the subfloor volume may be somewhat limited due to the relatively small height between raised floor and top of cabling, as well as physical barriers within the subfloor volume to meet IEEE 384 separation criteria. Not including automatic fire suppression within the subfloor volume has the indirect benefit of avoiding the potential for missiles (from gaseous suppression cylinders) or flooding/wetting (from water piping) during maintenance or testing activities to impact safety-related equipment within the Main Control Room Complex.

Finally, in the unlikely event that a fire in the Main Control Room were to require evacuation, use of either the Division I or Division II Remote Shutdown Panels (located remotely from Main Control Room, in the Reactor Building) enable the operators to bring the reactor to a safe shutdown.

9.5.1.12.1.4 Diesel Day Tank Capacity within Building

Section C.8.1.8.b of BTP SPLB 9.5-1 recommends that diesel day tanks comply with Regulatory Guide 1.189. Section 6.1.8 of Regulatory Guide 1.189 states in part:

"Day tanks with total capacity up to 4164 L (1100 gallons) may be located in the diesel generator area under the following conditions:

a. The day tank is located in a separate enclosure with fire resistance rating of at least 3 hours"

Based on the size of the nonsafety-related diesel generators, the capacity of each of the diesel day tanks will likely exceed 4164 L (1100 gallons) to allow enough fuel for at least 4 hours of diesel operation at the maximum load demand.

Technical Justification: The ESBWR design includes two independent and physically separated nonsafety-related diesel generators, either of which is capable of providing the full electrical load for the redundant nonsafety-related electrical buses. Neither diesel generator is necessary to achieve and maintain safe shutdown conditions for the 72 hour period following an accident or fire event. Each day tank is located in the Electrical Building in a dedicated 3 hour fire rated compartment of masonry or concrete construction. There is no safety-related equipment located in the same building as the day tank rooms. Additionally, the day tank rooms are located in individual fire areas adjacent to the Diesel Generator (DG) rooms and are positioned such that the 3 hour fire rated walls, ceiling, and floor of the day tank room are not common to the other redundant DG.

Each day tank room is protected by a foam water deluge system that can deliver foam to the room for a minimum of 30 minutes without operator intervention. The day tank is seismically designed and supported. Potential ignition sources, with enough energy to ignite diesel fuel, are limited inside the day tank rooms. Furthermore, the supply of fresh air to support combustion is limited. In the event of a fire, the automatic foam water deluge system is designed to extinguish a fire in this room in 10 minutes. In the unlikely event the day tank were to fail, the entire contents of the day tank plus the foam water volume can be contained in the sunken volume of the day tank room. Additional foam capacity beyond 10 minutes provides added assurance that a postulated fire will be extinguished. In the unlikely event the fire cannot be extinguished, the day tank room can be isolated by closing doors and dampers to allow the fire to burn out on its own without spreading to other fire areas.

In the event that the fuel oil transfer line from the day tank to the DG were to fail outside of the day tank room, the curbed area within the DG room can accommodate the contents of the day tank plus the foam water volume applied by the preaction foam water automatic sprinkler system. This automatic sprinkler system is designed to extinguish a fire within the DG room within 10 minutes. In the unlikely event the fire is still not extinguished, the DG room can be isolated by closing doors and dampers to allow the fire to burn out on its own without spreading to other fire areas. Alternatively, if the fire brigade is required to fight the fire manually, the curbed area within the DG room can accommodate additional water/foam application from two hand-held foam hose lines before reaching the lowest door opening. The lowest door opening to these rooms are the exterior equipment doors which could be opened if fire fighting activities necessitate so that any overflow would spill outside the building and not spread to other parts of the electrical building. Therefore, any overflow from the sump area of the room will not affect any other equipment, nor will it affect safe shutdown equipment or equipment needed for support of safe shutdown equipment.

9.5.1.12.1.5 Allowing Continued Diesel-Generator Operation During a Fire

Section 8.1.8.c of BTP SPLB 9.5-1 recommends that impacts of suppression systems on operating generators should be addressed in the fire hazard analysis. Section 6.1.8 of Regulatory Guide 1.189 states in part:

"Automatic fire suppression should be installed to suppress or control any diesel generator or lubricating oil fires. Such systems should be designed for operation when the diesel is running without affecting the diesel."

The automatic sprinkler systems in the diesel generator rooms are installed to extinguish any fire in those rooms and do not place restrictions on the positioning and direction of the application of the fire suppressant.

Justification: The automatic sprinkler systems used in the diesel generator rooms are designed to prevent inadvertent actuation by utilizing preaction automatic sprinkler type. The sprinkler piping and closed head sprinklers are pneumatically supervised for leakage, and any inadvertent actuation of the deluge valve during testing or maintenance will not result in unintentional water release due to the normally closed sprinkler heads.

Two actuation signals are required to automatically actuate the deluge valve, the first of which will annunciate an alarm to alert the operators to any potential problems. Automatic actuation of the sprinkler system to release water requires three independent events: 1) detection of a specific range of infrared wavelengths, consistent with burning oil, by at least one infrared detector; 2) detection of a significant heat release by at least one heat detector; and, 3) opening of at least one fusible link sprinkler head. Furthermore, each redundant diesel generator has its own dedicated fire detectors and preaction deluge valve for the control of the fire sprinklers in that room, and loss of power to the deluge valve does not cause actuation.

The ESBWR design includes two independent and physically separated nonsafety-related diesel generators, either of which is capable of providing the full electrical load for the redundant nonsafety-related electrical buses. Neither diesel generator is necessary to achieve and maintain safe shutdown conditions for the 72 hour period following an accident or fire event. The ESBWR design also includes four independent and physically separated safety-related divisions, any two of which are capable of bringing the plant to a safe shutdown in the event of a fire. For design purposes, it is assumed that a fire anywhere in a fire area results in the immediate loss of function of all equipment associated with that division. Even with this conservative assumption, the remaining independent safety-related divisions are available for full utilization by the operators.

9.5.1.12.1.6 No Automatic Fire Suppression in Safety-Related Computer Rooms

Section 8.1.4 of SPLB BTP 9.5-1 recommends protecting computer rooms with fire protection systems as described in Regulatory Guide 1.189. Section 6.1.4 of Regulatory Guide 1.189 states in part:

"Computer rooms for computers performing functions important to safety that are not part of the control room complex should be separated from other areas of the plant by barriers having a minimum fire resistance rating of 3 hours and should be protected by automatic detection and fixed automatic suppression."

ESBWR computer rooms containing safety-related equipment do not have fire suppression installed inside them.

Justification: Computer rooms are considered to be low risk fire areas, due to the lack of high- or medium-voltage equipment or cabling. Interior finishing materials within computer rooms are noncombustible. The amount of transient combustibles within computer rooms is limited. Papers within computer rooms, if any, are stored in file cabinets, bookcases, or other storage locations except when in use.

Ionization smoke detectors are installed throughout computer rooms to provide early warning of fire during the incipient stage. The Main Control Room Complex is continuously manned so that any fire will be quickly detected and manual fire suppression activities would be initiated quickly upon discovery of a fire in a computer room. Should manual fire fighting in a computer room be necessary using either portable fire extinguishers or hand held fire hoses, accumulation or drainage of fire water will not affect the ability to safely shutdown the reactor. If the fire water is assumed to transport immediately to the basement of the building, the resulting accumulation of water will not affect safety-related equipment located in the basement. In either case, the fire fighting activities will not prevent the reactor from being safely shutdown.

Except in the Main Control Room Complex, all safety-related computers are located in divisional rooms, and all divisional rooms are separated from each other by 3 hour fire-rated barriers such that a single fire will not affect computer equipment from multiple divisions. In the unlikely event that a fire in the Main Control Room were to require evacuation, use of either the Division I or Division II Remote Shutdown Panels (located remotely from Main Control Room, in the Reactor Building) enable the operators to bring the reactor to a safe shutdown.

The radios are equipped with tone-coded squelch so that a message cannot be received unless the message contains the proper address code. Therefore, individual, all-channel (zone), and all-system calls can be made. The emergency channel is not coded. Calls are made between the telephone system and the in-plant radio system by dialing through the PABX to a radiotelephone interconnect panel.

The portable, handheld radios are site-specific components.

Any portable radio systems operate at frequencies within the EMI/RFI test envelope for DCIS components.

Evacuation Alarm and Remote Warning System

The evacuation alarm and remote warning system is provided to warn personnel of emergency conditions. This system supplements the Area Radiation Monitoring System described in Subsection 12.3.4.

The evacuation alarm system consists of a siren tone generator, public address system speakers, and an outdoor siren. A selector switch in the MCR is used to manually initiate the evacuation alarm. This selector switch also selects the evacuation alarm coverage in the drywell or the entire plant including the initiation of the outdoor siren and the remote broadcast speakers.

The remote warning system consists of a tape recorder, microphone, remote broadcast speakers, and an output/feedback monitoring system. The tape recorder transmits recorded messages and the microphone transmits warning instructions through the remote broadcast speakers. An initiation signal from the MCR starts the tape recorder or opens the microphone available for transmission.

The output/feedback monitoring system monitors the output of the remote broadcast speakers and retransmits the output back to the monitoring speaker when the tape recorder is initiated or to the sound level (VU) meter when the microphone is activated. The monitoring speaker and sound level (VU) meter are located in the MCR.

Power for this system is supplied from a nonsafety-related bus backed from standby on site AC power supply system and backed by the station batteries.

Emergency Communication Systems

Normal and emergency off-site communications are provided by public telephone lines and the private utility network connected to the PABX.

In addition, the following radio systems provide both in-plant and plant-to-off-site emergency communications:

- Security radio system in accordance with 10 CFR 73.55(f)
- Crisis management radio system in accordance with the intent of NUREG-0654
- Fire brigade radio system in accordance with BTP SPLB 9.5-1, position C.5.g(4)

The security and crisis management radio systems are powered from the security system power supply that is backed up by batteries and a standby generator.

The off-site security radio system and the crisis management radio system are site specific.

9A.2 ANALYSIS CRITERIA

9A.2.1 Codes and Standards

The Table 9A.2-1 applicable codes and standards are incorporated in the design of the ESBWR Reference Plant, including the fire detection and suppression systems designs, to the maximum extent practicable. These codes and standards differ slightly from those listed in NRC Branch Technical Position SPLB 9.5-1 in order to reflect the applicable code titles specified in the 2004 National Fire Code by the NFPA.

9A.2.2 Fire Area Separation and Fire Equipment Drawings

Drawings showing the fire area separation and fire protection for the Reactor Building, Fuel Building, Control Building, Turbine Building, Radwaste Building, and Electrical Building are included as Figures 9A.2-1 through 9A.2-32. The COL applicant shall include drawings showing the fire area separation and fire protection features for the Yard Service Water Pump Building and Service Building. .

9A.2.3 Terminology

Fire Area - portion of a building or plant that is separated from other areas by rated fire barriers.

Fire Barrier - components of construction (i.e., walls floors and ceilings) that are used to prevent the spread of fire. Rated fire barriers are those fire barriers (i.e., walls, floors, ceilings, and their supports, including beams, joists, columns, penetration seals or closures, fire doors and fire dampers) that are rated, or capable of being rated, by approving laboratories in hours of resistance to fire and are used to prevent the spread of potential fire.

Fire Suppression - control and extinguishing of fires. Manual fire suppression includes the use of hoses, portable extinguishers or fixed systems by plant personnel. Automatic fire suppression is the use of automatically actuated, fixed systems such as water (systems).

Fire Zones - subdivisions of fire areas containing fire suppression systems designed to combat particular types of fires.

Noncombustible Materials - materials having any one of the following characteristics:

- Materials no part of which can ignite and burn, support combustion, or release flammable vapors when subjected to a fire or heat;
- Materials having a structural base of non-combustible material, as defined in the above item, with a surfacing not over 1/8 inch thick which has a flame spread rating not higher than 50 when measured using ASTM E-84; or
- Materials, other than as described in the above two items, having a surface flame spread rating not higher than 25 without evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material in any way would not have flame spread rating higher than 25 without evidence of continued progressive combustion.

The flame-spread ratings referred to above are obtained according to NFPA 255, "Method of Test of Surface Burning Characteristics of Building Materials."