GE Energy

Security Notice
This letter forwards Security-Related information in accordance with 10CFR2.390. The balance of this letter may be considered non-Security-Related upon the removal of Enclosure 1.

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MFN 06-304

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U.S. Nuclear Regulatory Commission
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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 42 Related to ESBWR Design Certification Application – Fire Protection – RAI Numbers 9.5-4 through 9.5-22, 9.5-24 and 15.5-3**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter. This completes GE's response to RAI Letter No. 42.

Enclosure 1 contains Security-Related information identified by the designation "{{{Security-Related Information - Withhold Under 10 CFR 2.390}}}." GE hereby requests this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390. A public version is contained in Enclosure 2

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

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

D068

Reference:

1. MFN 06-233, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 42 Related to ESBWR Design Certification Application,* July 13, 2006

Enclosures:

1. MFN 06-304 – Response to Portion of NRC Request for Additional Information Letter No. 42 Related to ESBWR Design Certification Application – Fire Protection – RAI Numbers 9.5-4 through 9.5-22, 9.5-24 and 15.5-3 – Security-Related Information
2. MFN 06-304 – Response to Portion of NRC Request for Additional Information Letter No. 42 Related to ESBWR Design Certification Application – Fire Protection – RAI Numbers 9.5-4 through 9.5-22, 9.5-24 and 15.5-3 – Public Version

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ENCLOSURE 2

MFN 06-304

Response to Portion of NRC Request for

Additional Information Letter No. 42

Related to ESBWR Design Certification Application

Fire Protection

RAI Numbers 9.5-4 through 9.5-22, 9.5-24 and 15.5-3

Public Version

NRC RAI 9.5-4

Although this section states that water for the fire protection system is supplied from a minimum of two reliable sources, only a single fire water storage tank is shown on DCD Tier 2, Figures 1.1-1 and 9A.2-22. Presumably these figures reflect a site where an existing fire water storage tank will provide the second fire water system (FWS) tank. A note should be added to the figures to address the requirement for two separate tanks.

GE Response

Two sources of fire water will be supplied as shown on DCD Tier 2, Figure 9.5-1. The RAI reference to DCD Tier 2, Figure 9A.2-22 should be to DCD Tier 2, Figure 9A.2-33. To clarify, the following note will be added to DCD Tier 2, Figure 1.1-1 (note 3) and Figure 9A.2-33 (note 4).

THIS SITE CONTAINS A SECOND RELIABLE SOURCE OF WATER FOR THE FIRE PROTECTION SYSTEM. THE SECOND RELIABLE SOURCE HAS SUFFICIENT CAPACITY TO MEET THE MAXIMUM WATER DEMAND OF THE SYSTEM FOR A PERIOD OF TWO HOURS. WATER SOURCES THAT ARE USED FOR MULTIPLE PURPOSES ENSURE THAT THE REQUIRED QUANITITY OF WATER IS DEDICATED FOR FIRE PROTECTION ONLY.

NRC RAI 9.5-5

In accordance with Section 9.5.1 of the SRP, Revision 4, October 2003, Section I, add, "and will not significantly increase the risk of radioactive releases to the environment." to the end of the third defense-in-depth principle in DCD Tier 2, Section 9.5.1.1.

GE Response

In accordance with Section 9.5.1 of the SRP, Revision 4, October 2003, Section 1, the third bullet of defense-in-depth principle in DCD Tier 2, Section 9.5.1.1, will be revised to state: To provide protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished by the fire suppression activities does not prevent the safe shutdown of the plant and will not significantly increase the risk of radioactive release to the environment.

NRC RAI 9.5-6

In accordance with Section 9.5.1 of the SRP, Revision 4, October 2003 and RG 1.189, April 2001, the fire protection program should demonstrate that the plant will maintain the ability to minimize the potential for radioactive releases to the environment in the event of a fire. (We note that Appendix 9A of the ESBWR identifies the potential for radiological release for each fire area). Add a design basis element for radiological release.

GE Response

In accordance with Section 9.5.1 of SRP, Revision 4, October 2003 and RG 1.189, April 2001, DCD Tier 2, Section 9.5.1.1 ESBWR fire protection program design bases element will be revised to state the design basis element: To maintain the ability to minimize the potential for radioactive releases to the environment in the event of a fire.

NRC RAI 9.5-7

DCD Tier 2, Section 9.5.1.1 states that automatic fire detection and annunciation will be provided for "selected" areas of the plant and Section 9.5.1.2 says that detection is provided in "various locations" throughout the plant, whereas Section 8.3.3.4 states that "all" areas of the plant are covered by a fire detection and alarm system. Section 9.5.1 of the SRP, Revision 4, October 2003, Branch Technical Position (BTP) SPLB 9.5-1, Section C6.1 states that detection should be provided in areas that contain equipment important to safety. Verify which of the two statements in the DCD is correct and revise the DCD accordingly.

GE Response

The correct statement is that automatic fire detection and annunciation for selected areas of the plant as required by the Fire Hazards Analysis for personnel safety and fire brigade notification.

DCD Tier 2, Sections 9.5.1.1 and 9.5.1.2 will be revised to incorporate the above wording.

Because fire detection and protection systems are covered in DCD Tier 2, Section 9.5.1, Section 8.3.3.4 of DCD Tier 2 will be removed.

NRC RAI 9.5-8

The DCD Tier 2, Section 9.5.1.3 states that exceptions to the BTP SPLB 9.5-1 requirements for circuit routing and separation will be "analyzed and justified as acceptable on an individual basis." Provide the acceptance criteria for such exceptions.

GE Response

Exceptions to this requirement are analyzed and justified as acceptable on an individual basis. The acceptance criteria is that a single fire cannot degrade the performance of more than one division of safe shutdown equipment controlled from the main control room. If however, alternate means of control or indication are provided or available that remain unaffected by the same fire, then exception to "the BTP SPLB 9.5-1 requirements for circuit routing and separation" may be taken. The alternate means of control or indications are not required to be safety related.

DCD Tier 2, Section 9.5.1.3 will be revised to include the above acceptance criteria

NRC RAI 9.5-9

The DCD Tier 2, Section 9.5.1.3 states that safety-related cables conform to the Institute of Electrical and Electronics Engineers (IEEE) 383 flame test. In accordance with Section 9.5.1 of the SRP, Revision 4, October 2003, BTP SPLB 9.5-1 Section C7.1.4, all cable should meet the flame test criteria of IEEE 383 or IEEE 1202.

GE Response

The 2003 edition of IEEE-383 no longer contains flame test criteria, but rather refers to IEEE-1202 for flame testing of electrical cables.

In accordance with Section 9.5.1 of the SRP, Revision 4, October 2003, BTP SPLB 9.5-1 Section C7.1.4, DCD Tier 2, Section 9.5.1.3 will be changed to state: All electrical cables (safety-related and nonsafety- related) conform to the IEEE 1202 flame test criteria.

NRC RAI 9.5-10

The enhanced fire protection criteria of Appendix B of Section 9.5.1 of the standard review plan (SRP), Revision 4, October 2003, requires that the design must ensure that smoke, hot gases, or fire suppressant will not migrate into other fire areas to the extent that they could adversely affect safe shutdown capabilities, including operator actions. Provide the ESBWR design criteria to address this hazard.

GE Response

As shown throughout DCD Tier 2 Appendix 9, gaseous fire suppressant is not used in buildings containing safety-related equipment. In accordance with Appendix B Section 9.5.1 SRP, Revision 4, October 2003, ESBWR design criteria will incorporate fire-rated doors, fire-rated penetration seals, and smoke dampers to prevent smoke and hot gases from migrating into other fire areas. Upon detection of smoke, the smoke dampers will automatically close and isolate the fire area containing the affected division to prevent smoke or hot gases from migrating.

DCD Tier 2, Sections 9.4.1.2, 9.4.6.1, and 9.5.1.11 will be revised to include the above criteria.

NRC RAI 9.5-11

The smoke control systems described in DCD Tier 2, Section 9.5.1.11 appear to be for use only after a fire has been extinguished. Section 6.4.4 of NFPA 804, 2001 Edition, requires that smoke control systems be provided to facilitate manual fire fighting in high-density cable-use areas, switchgear rooms, diesel fuel oil storage areas, turbine buildings and other areas where potential exists for heavy smoke and heat conditions as determined by the fire hazards analysis. These requirements are similar to those in Section 4.1.4.2 of Regulatory Guide (RG) 1.189, April 2001. What provisions does the ESBWR include for smoke and heat removal during a fire?

GE Response

As shown in DCD Tier 2, Tables 9A.5-4, 9A.5-6, and 9A.5-7, the high density cable tunnels, fuel oil day tank, diesel-generator rooms, and a significant portion of the turbine building are provided with automatic sprinkler protection, to limit smoke and heat generation. As stated in the Exception to Section 6.4.3.1 of NFPA 804, 2001 Edition; for those plants provided with complete automatic sprinkler protection, fixed ventilation systems for the removal of smoke is not required.

Generally, smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified by the Fire Hazards Analysis.

DCD Tier 2, Sections 9.4.1.1, 9.4.2.1, 9.4.3.1, 9.4.4.1, 9.4.6.1, 9.4.7.1 and 9.5.1.11 will be revised to include the above criteria.

NRC RAI 9.5-12

As noted in the DCD Tier 2, Section 9.5.1.12.1.1, Section 6.1.2.2 of RG 1.189, April 2001 states that smoke detectors should be provided in control room consoles and cabinets. The justification provided in the DCD is based partly on ceiling mounted area detection and detection by operators. Detectors in individual electrical cabinets provide additional protection by providing early detection of invisible products of combustion and by providing operators with the specific location of the incipient fire. This will allow rapid extinguishment of the fire and minimize the potential for control room evacuation. If the final fire hazard analysis indicates that a fire in a Main Control Room (MCR) cabinet is a significant fire hazard, the in-cabinet detectors should be provided. The DCD should be revised accordingly.

GE Response

DCD Tier 2, Section 9.5.1.12.1.1 will be revised to state: ESBWR consoles and electrical cabinets do not have fire detectors installed inside them, unless identified as a significant fire hazard in the Fire Hazards Analysis.

NRC RAI 9.5-13

As noted in the DCD Tier 2, Section 9.5.1.12.1.2, Section 6.1.2.c of RG 1.189, April 2001 states in part that peripheral rooms in the control room complex should have automatic water suppression..." The office areas may contain significant levels of combustible materials and there are no provisions for smoke removal during a fire. An automatic water suppression system will reduce the potential for a forced evacuation due to smoke migration to the main control room, as well as minimize the extent of the fire damage, and should be provided. If the final fire hazard analysis indicates that a fire in a room adjacent to the MCR is a significant fire hazard, auto suppression systems should be provided. The DCD should be revised accordingly.

GE Response

DCD Tier 2, Section 9.5.1.12.1.2 will be revised to state: The office spaces contained in the ESBWR Main Control Room Complex do not have automatic fire suppression systems installed, unless identified as a significant fire hazard in the Fire Hazards Analysis.

NRC RAI 9.5-14

Section 6.1.2.1 of RG 1.189, April 2001 states that area automatic suppression should be provided for under-floor areas unless cable is run in less than or equal to 4-inch steel conduit. The description in DCD Tier 2, Section 9.5.1.12.1.3 of the circuits that will be routed below the raised floor in the control room complex indicates that there will be significant combustible loading in this area and does not state that it will be run in steel conduit less than or equal to 4-inch. Since access to this area is by lifting individual panels and detection of a fire is by general area detectors, it may be difficult to locate a fire quickly enough to manually suppress the fire before evacuation of the main control room is required. If the final fire hazard analysis indicates that a fire below the MCR is a significant fire hazard, an auto suppression system should be provided (consideration should be given to a water mist system per NFPA 750). The DCD should be revised accordingly.

GE Response

DCD Tier 2, Section 9.5.1.12.1 will be revised to state: The subfloor volume includes full fire detection but does not include any automatic fire suppression system, unless identified as a significant fire hazard in the Fire Hazards Analysis.

NRC RAI 9.5-15

A fire pump flow rate of 2,000 gpm is indicated for all three fire pumps in DCD Tier 2, Table 9.5-2. The criteria for sizing the pumps (included in Section 7.2.1 of NFPA 804, 2001 Edition) is to provide sufficient flow for the single largest design demand of any sprinkler or fixed water spray system plus 500 gpm for manual hose streams. Identify the system with the single largest design demand and the required flow for that system.

GE Response

The single largest non-SC I design basis fire would result from catastrophic failure of the Turbine Generator with cascading oil down to lower levels. This could actuate the following non-SC I suppression systems:

1) Turbine Bearing preaction spray (624 gpm)

2) Under Turbine wet-pipe sprinkler (2400 gpm)

3) Steam Tunnel water curtain deluge (432 gpm)

4) Seal Oil Skid (300 gpm)

The maximum resulting combined flow rate plus manual hose streams (500 gpm) would be:

624 gpm + 2400 gpm + 432 gpm + 300 gpm + 500 gpm = 4256 gpm

The largest non-SC I fire water demand (4256 gpm for Turbine Building) is more than double the fire water demand for the largest SC I fire water demand (1250 gpm for manual fire fighting in the Reactor Building). With the large disparity in flow rates, the most economical arrangement is to use multiple fire pumps in parallel, allowing any one pump to be out of service and fire water supplied by two operating fire pumps.

Each of the fire pumps shall be able to deliver the following:

4256 gpm / 2 = 2128 gpm

Allowing fire pumps to operate at up to 140% of their rate, capacity as allowed by NFPA 20 results in the following minimum capacity:

2128 gpm / 1.4 = 1520 gpm

Therefore 2000 gpm rated capacity main fire pumps are used.

The following clarification note will be added to the water supply volume in DCD Tier 2, Table 9.5-2: *** based on the largest firewater demand of 4256 gpm for Turbine Building, including hose stream.

NRC RAI 9.5-16

DCD Tier 2, Table 9A.5-1, Reactor Building, Area F1210, Division I Battery Room does not address the potential for accumulation of hydrogen and an explosive hazard (this RAI is typical for all plant safety-related battery rooms). If there is the potential for an explosive concentration of hydrogen in these rooms, describe the ventilation features provided to prevent an explosion. Section 8.3.2.1.1 describes a ventilation system but does not mention that loss of ventilation will be alarmed in the control room as required by Section 6.1.7 of RG 1.189, April 2001. Also verify that DC switchgear and inverters are not located in the battery room.

GE Response

Safety-related battery rooms consist of fire areas F1210, F1220, F1230, and F1240 at EL-6400 in the Reactor Building. DC switchgear and inverters are not located within battery rooms, but rather are located in electrical equipment rooms at EL-1000; the battery rooms contain only batteries and eye wash stations.

As shown in Section 9.4.6.1 of DCD Tier 2, one of the design bases of the Reactor Building HVAC system (RBHVS) is to maintain hydrogen concentration levels in each of the battery rooms below 1% by volume. This is accomplished by providing fresh air to each battery room from the common HVAC system and by exhausting the air by separate battery room exhaust fans as shown in Figure 9.4-9 and Table 9.4-9 of DCD Tier 2. Battery exhaust fans are one type of RBHVS component that is monitored and indicated in the Main Control Room (MCR) as discussed in Section 9.4.6.5 of DCD Tier 2.

DCD Tier 2, Table 9A.5-1 for fire areas F1210, F1220, F1230, and F1240 will be revised to identify the battery room exhaust fans alarmed to MCR.

NRC RAI 9.5-17

Section 4.1.8 of RG 1.189, April 2001 requires that systems that involve hydrogen supplies should be designed to prevent explosive mixtures. DCD Tier 2, Table 9A.5-1. Reactor Building, Area F1450, Hydrogen Gas A contains 16m3 of hydrogen. Address the potential for a hydrogen explosion and the consequences for this area and the redundant, Train B area.

GE Response

The potential for a hydrogen buildup in Reactor Building Fire Areas F1450 and F1460 is mitigated by louvers in the top and bottom of the 3-hr fire rated exterior walls. The louvers create natural circulation that allows fresh outside air to enter from the bottom and exit from the top of the walls. This configuration will automatically ventilate any hydrogen buildup that might develop from a small leak in the hydrogen bottles.

Ignition within Fire Area, F1450 or F1460 is prevented by requiring all electrical devices in those areas to be rated for NEC Group B Class I Division II. In the unlikely event of an ignition and explosion in either Fire Area F1450 or F1460, damage to the Reactor Building or Control Building is prevented by 3-hr fire rated reinforced concrete walls that are approximately 1.5 meters thick for the nearby Reactor Building and approximately 0.7 meters thick for the Control Building which is further away. Damage to the redundant hydrogen system is prevented by physically separating Train A Fire Area F1450 from Train B Fire Area F1460 by over 50 meters and surrounding each by 3-hr fire rated concrete walls, including penetration seals and doors. Additionally, as shown in DCD Tier 2 Figure 9A.2-4, the Reactor Building structure is located between Fire Areas F1450 and F1460.

DCD Tier 2 Table 9A.5-1 for Fire Areas F1450 and F1460 will be revised to include the above evaluation.

NRC RAI 9.5-18

The form in DCD Tier 2, Table 9A.5-3 for area F3270, Main Control Room (MCR) Complex, indicates "none" for safety-related divisional equipment or cables. This should be changed to indicate the presence of all four trains.

GE Response

Main Control Room will contain all four divisions of safety-related cables.

DCD Tier 2, Table 9A.5-3 for fire area F3270, Safety-related divisional equipment or cables will be revised to indicate all four divisions: I, II, III, IV.

NRC RAI 9.5-19

The form in DCD Tier 2, Table 9A.5-1 for area F4100, Turbine Building, indicates that Division I, II, III, and IV cables and equipment are located in this area. Identify and provide location by room of all safety-related equipment and cables in the turbine building, if other than the main steam isolation valves (MSIVs) and associated cables. The table also states that complete burnout of all equipment and cables within the fire area affects no safe-shutdown divisions. Explain this conclusion.

GE Response

Safety-related devices within the Turbine Building are limited to the instrumentation listed in the Table 9A.6-1.

The safety-related RPS input devices listed in the Table 9A.6-1 provide a monitoring function of the measured parameter. The safety-related RPS output devices listed in the table receive a signal from the RPS to initiate an anticipatory trip of the Feedwater Pumps. The devices listed in the table are provided for DCD Tier 2, Chapter 15, Analysis of Anticipated Operating Occurrences, and DCD Tier 2, Chapter 15, Analysis of Infrequent Events, and do not perform a safe-shutdown function in the event of a fire.

The cables associated with these devices will be routed in individual raceway specific to their associated division, and will be separated in accordance with IEEE 384 criteria and Subsection 8.3.1.4.1. Because these devices and their associated cables do not perform a safe shutdown function, complete burnout of all of these devices and their associated cables within their fire area does not affect the ability to achieve and maintain post-fire safe-shutdown, as shown in the attached table.

A new section 9A.6.4.13 will be added to DCD Tier 2, incorporating the above evaluation. DCD Tier 2, Table 9A.5-4 will be revised to reference Sections 9A.6.4.2, 9A.6.4.3, 9A.6.4.5, and 9A.6.4.13.

NRC RAI 9.5-19 (continued)

Table 9A.6-1
Turbine and Electrical Building Safety-related Monitoring Devices

Parameter Description	RPS Input or Output	Parameter Measuring or Actuating Device	Building	Room	Divisions	Total Burnout Impact With No Hot Short	Total Burnout Impact With Hot Short
Condenser Vacuum	Input	Transmitter (Analog signal between upper and lower limits)	TB	4392	I, II, III, IV	Indication to RPS of Loss of Condenser Vacuum; Refer to Subsection 15.2.2.8	Indication to RPS of Loss of Condenser Vacuum; Refer to Subsection 15.2.2.8
Main Steam Line Pressure	Input	Transmitter (Analog signal between upper and lower limits)	TB	4390	I, II, III, IV	Indication to RPS of Closure of All Main Steamline Isolation Valves; Refer to Subsection 15.2.2.7	Indication to RPS of Closure of All Main Steamline Isolation Valves; Refer to Subsection 15.2.2.7
Turbine Bypass Valve Position	Input	Position Switch	TB	4391 and 4392	I, II, III, IV	Indication to RPS of Turbine Bypass Valves Opening; Refer to Subsection 15.3.3.1	Loss of RPS Ability to Monitor Turbine Bypass Valve Position
Turbine Stop Valve Position	Input	Position Switch	TB	4380	I, II, III, IV	Indication to RPS of Turbine Stop Valves Closing; Refer to Subsections 15.3.6.1	Loss of RPS Ability to Monitor Turbine Stop Valve Position
Turbine Control Valve Position	Input	Transmitter (Analog signal between upper and lower limits)	TB	4506 and 4507	I, II, III, IV	Indication to RPS of Turbine Control Valves Closing; Refer to Subsection 15.3.4.1	Indication to RPS of Turbine Control Valves Closing; Refer to Subsection 15.3.4.1
Turbine Area Temperatures (Main Steam Leak Detection)	Input	Temperature Elements (Analog signal between upper and lower limits)	TB	4390 and 4393	I, II, III, IV	Indication to RPS of Main Steamline Leak; Refer to Subsections 9A.6.4.2 and 15.2.2.7	Indication to RPS of Main Steamline Leak; Refer to Subsections 9A.6.4.2 and 15.2.2.7

NRC RAI 9.5-19 (continued)

Table 9A.6-1

Turbine and Electrical Building Safety-related Monitoring Devices (continued)

Parameter Description	RPS Input or Output	Parameter Measuring or Actuating Device	Building	Room	Divisions	Total Burnout Impact With No Hot Short	Total Burnout Impact With Hot Short
Safety-Related Feedwater Pump Breaker Trip	Output	Breaker Trip Coils	TB	4102	I, II	Loss of RPS Ability to Trip Feedwater Pumps	Trip of all Feedwater Pump Breakers Resulting in Loss of Feedwater Flow; Refer to Subsection 15.2.5.3
Safety Related Feedwater Pump Breaker DC Control Power	N/A	Breaker Trip Coils	TB	4102	I, II	Loss of RPS Ability to Trip Feedwater Pumps	Loss of RPS Ability to Trip Feedwater Pumps
Feedwater Line Diff. Pressure (Indication of Feedwater Pump Runout)	Input	Transmitter (Analog signal between upper and lower limits)	TB	4293	I, II, III, IV	Indication to RPS of Feedwater Pump Runout; Refer to Subsection 15.2.4.2	Indication to RPS of Feedwater Pump Runout; Refer to Subsection 15.2.4.2

NRC RAI 9.5-20

NFPA 804, 2001 Edition and RG 1.189, April 2001 require spill containment for oil-filled transformers and for fuel oil storage tanks. The fire hazards analysis does not indicate the provision of spill control. Describe where spill control is provided and the design criteria for the containment sizing - should include an appropriate volume for any fire suppression water.

GE Response

Spill control is provided to contain the contents of any above grade oil-filled vessel or tank larger than 55 gallon and all tanks containing chemicals used in water/wastewater treatment or quality control.

In accordance with NFPA 804, 2001 Edition and RG 1.189, April 2001, the following design criteria is used for containment sizing:

Drainage and any associated drainage facilities for a given area is sized to accommodate the volume of liquid produced by all the following:

(1) The spill of the largest single container of any flammable or combustible liquids in the area.

(2) Where automatic suppression is provided throughout, the credible volume of discharge (as determined by the fire hazards analysis) for the suppression systems operating for a period of 30 minutes.

(3) Where automatic suppression in not provided throughout, the contents of piping systems and containers that are subject to failure in a fire.

(4) Where the installation is outside, credible environmental factors such as rain and snow.

(5) Where automatic suppression is not provided throughout, the volume shall be based on a manual fire-fighting flow rate of 500 gal/min (1892.5 L/min) for a duration of 30 minutes, unless the fire hazards analysis demonstrates a different flow rate and duration.

The above criteria will be incorporated at the end of Section 9A.2.4 of DCD Tier 2, Appendix 9A.

NRC RAI 9.5-21

The power generation design bases state that manual suppression capability is provided to all areas of the plant and that one effective hose stream can reach any location containing safe shutdown equipment. Please clarify whether this includes areas inside the containment (there is no mention in the DCD of water suppression systems inside the containment and no mention of a containment penetration for the fire protection system).

GE Response

DCD Tier 2, Table 9A.5-1 for fire area F1170 identifies that backup fire suppression for Drywell and Containment consists of hose racks and ABC fire extinguishers (via hatches at EL -6400, EL 13570, and EL 17500.) Hose racks are located in each stairwell, with extra fire hose and fire extinguishers staged at hatch openings as required, to provide full coverage throughout the Drywell and Containment during outages. No fire suppression is provided during reactor operation because it is an inerted atmosphere and cannot sustain a fire.

EL 34000 will be removed from backup fire suppression for fire area F1170 in Table 9A.5-1 of DCD Tier 2, due to EL 34000 no longer having floor access hatches into containment.

These clarifications will be incorporated into DCD Tier 2, Table 9A.5-1 for fire area F1170.

NRC RAI 9.5-22

NRC Generic Letter (GL) 2006-03, "Potentially Nonconforming Hymyc and MT Fire Barrier Configurations," (ML 053620142) provides the most current guidance on the design and testing of ERFBS. IF the ESBWR Standard Plant Design utilizes electrical raceway fire barrier systems (ERFBS), describe how they will be in accordance with this GL. Also, describe the application and the design criteria and test acceptance criteria.

GE Response

The intent is to avoid use of electrical raceway fire barrier systems (ERFBS) for ESBWR, instead relying on divisional separation by fire area and structural fire barriers.

DCD Tier 2, Section 9.5.1.3 will be revised to include the above clarification.

NRC RAI 9.5-24

The following additional COL items should be included in DCD Tier 2, Table 1.10-1:

- *Final quantity and capacity of fire water storage tanks*
- *Final fire pump flow rate and head*
- *Details of the QA program for the fire protection program*
- *Applicability of RG 1.91, Revision 1, February 1978*
- *Applicable editions of codes and standards (within 6 months of COL docket date)*
- *Details of manual fire-fighting capability, including smoke control during a fire*
- *Description of electrical cable insulation and jacketing materials*
- *Details of electric cable and raceway penetrations of fire barriers, including tests and acceptance criteria*
- *Details of electrical raceway fire barrier systems, including tests and acceptance criteria if applicable*
- *Details of steam tunnel water spray curtain system between turbine building and reactor building*
- *Description of program that ensures that the inspections and tests performed on the fire protection system verify that the system parameters specified in the DCD are enveloped by the as-built parameters*
- *Complete description of the licensee's fire protection program*
- *Proposed fire protection license condition for making changes to the fire protection system without prior review and approval of the NRC*
- *Fire protection system piping and instrumentation diagram showing complete site-specific system*

GE Response

DCD Tier 2, Table 1.10-1 is affected by this RAI response, but a markup of DCD Table 1.10-1 is not attached to this response at this time. The version of Table 1.10-1 in DCD Revision 1 is considered to be preliminary because the DCD Revision 1 production schedule did not allow time for it to be fully updated to include all COL action items throughout Revision 1 of the DCD. A final complete version of DCD Table 1.10-1 that summarizes all COL action items will be produced after all DCD sections have been updated to Revision 2 Status.

NRC RAI 15.5-3

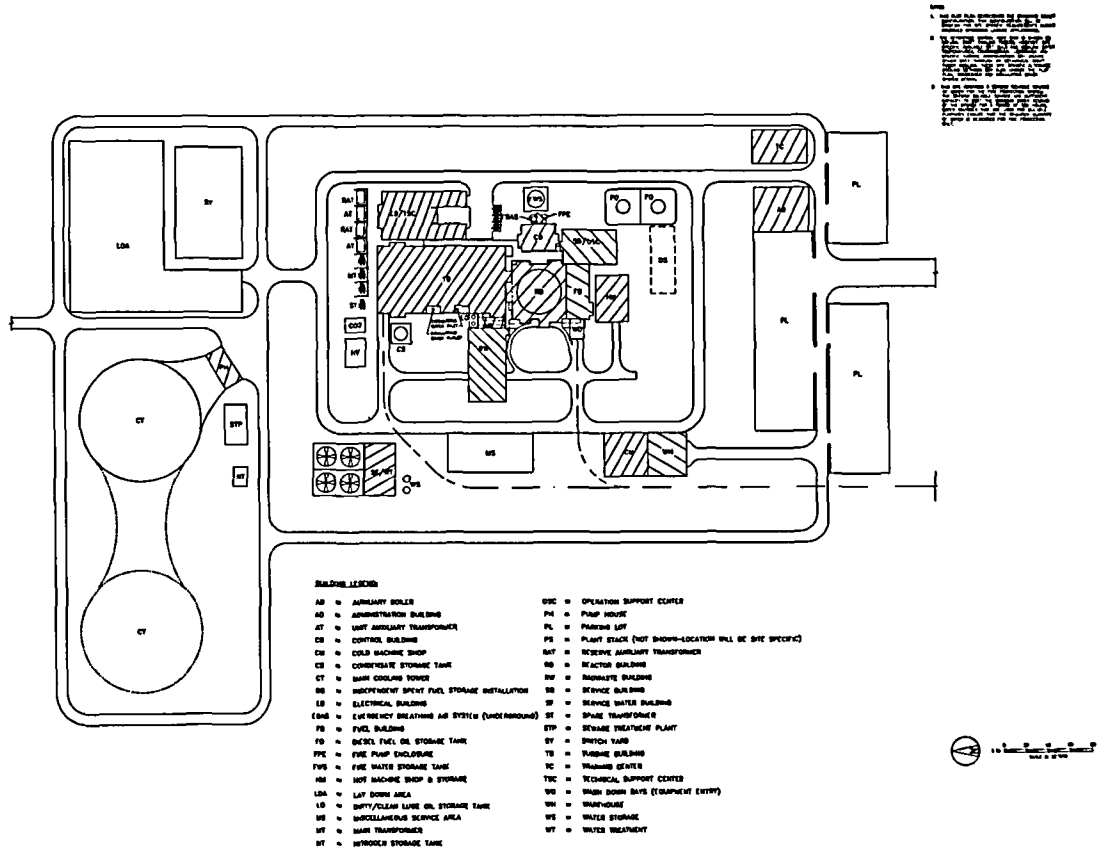
Provide the bases for the assumption that a fire in the main control room that requires operator evacuation cannot cause a spurious actuation of the safety relief valves (SRVs) or depressurization valves (DPVs). For post-fire, safe-shutdown circuit analyses, in general, the NRC has recently issued clarification of regulatory requirements regarding fire induced spurious actuations. That guidance is provide in Regulatory Issue Summary (RIS) 2005-30, "Clarification of Post-Fire Safe-Shutdown Circuit Regulatory Requirements, dated December 20, 2005 and draft Generic Letter 2005-XX, "Post-Fire Safe-Shutdown Circuit Analyses Spurious Actuations." Confirm that the ESBWR post-fire, safe shutdown circuit analyses are in compliance with the regulatory expectations described in these generic communications. (DCD Tier 2, Section 15.5.6)

GE Response

The ESBWR post-fire, safe shutdown circuit analyses have not been developed at this time. These analyses will be developed later in the project life cycle as part of the plant specific fire protection program. These analyses are developed later because the specific DCIS platform and detailed electrical design are required. The fire protection program and supporting analyses will be constrained by the associated DCD inputs and assumptions.

Note that, in general, the conceptual design of the ESBWR DCIS supports the DCD assumption of no spurious SRV or DPV actuations for a main control room (MCR) fire. The MCR environment (HVAC and Fire Area) is separate from the safety and non-safety DCIS rooms. The MCR communicates with the DCIS via Visual Display Units (VDUs) This is a digital communications interface using fiber optic cable which precludes potential hot shorts that may be encountered in hard wired systems resulting in spurious actuations of these valves. The VDU provides layered control, such that a series of specific commands are required to initiate a control task to the DCIS. It is not credible that a MCR fire would initiate the correct series of specific commands to result in a specific communication task to the DCIS.

Circuit designs of hard-wired SRV or DPV actuating devices, if employed in the Main Control Room, are expected to comply with RIS 2005-30 mentioned in the RAI above and draft generic letter 2005-XX titled "Post-Fire Safe Shutdown Circuit Analyses Spurious Actuations" when the final letter is issued by the NRC.



- Provides a controlled environment for the proper operation and integrity of equipment in the Control Building during normal, startup and shutdown operations.
- Provides redundant active components to increase reliability, availability and maintainability of the ventilation system.
- Provides shutoff dampers on the inlet and outlet of fans and air handling units (AHU) to allow for maintenance.
- Provides shutoff valves at the inlet and outlet of cooling and heating coils to allow for maintenance.
- Provides access doors for AHU fans, filter sections and duct mounted dampers to allow for maintenance.
- Provides the capability for manual control of system fans to facilitate maintenance and testing.
- Minimizes exposure to personnel during inspection and maintenance by locating equipment and instrumentation as far as practical from potential sources of high radiation.
- Maintains higher than atmospheric (positive) pressure to minimize the infiltration of outside air. Construction materials and processes ensure the Control Building structure maintains low leakage or leak tight conditions above and below grade. The CRHA envelope penetrations are sealed and access doors are designed with self-closing devices that close and latch the doors following use. There are double door airlocks in the CRHA envelope for access and egress during emergencies when the CRHA is isolated and EBAS is operating.
- Reduces the potential spread of airborne contamination by maintaining airflow from areas of lower potential for contamination to areas of greater potential for contamination. The CRHA is maintained at a higher pressure than surrounding areas.
- Detects and limits the introduction of airborne hazardous materials (radioactivity, smoke, chlorine gas, or other site-specific toxic gas) into the CRHA. Details regarding site-specific toxic gases will be described by the site-specific toxic gas study.
- Provides the capability to exhaust smoke, heat and gaseous combustion products from inside the Control Building to the outside atmosphere in the event of a fire. Construction materials and processes ensure that materials of construction are non-combustible and heat and flame resistant wherever possible. Materials that produce toxic or noxious vapors when subjected to a fire are avoided.
- Smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified by the Fire Hazards Analysis.
- Is designed such that failure of the system does not compromise or otherwise damage safety-related equipment.
- Is provided with bullet-resistant exterior HVAC openings that penetrate the MCR vital envelope in accordance with 10 CFR 73.

- Electric duct heaters and unit heaters provide heat when required to maintain minimum space temperature. Thermostats control the unit heaters to maintain the space temperatures. Heating coils are provided in the supply AHUs when required to preheat the outside air
- Cooling coils are provided in the supply AHUs and provide cooling to the CRHA and Control Building general areas as required to maintain design conditions

Standby Operating Mode, in the event of low airflow in a supply or exhaust duct:

- The operating AHU and return/exhaust fan trips and the associated isolation dampers close.
- The standby AHU and return/exhaust fans start and associated dampers automatically open.

Fire/Smoke Operating Modes

The following is a brief description of the Fire/Smoke Operating Modes. For a more complete description of the interface between the HVAC systems and the Fire Protection System, refer to Section 9.5.1.2.9.

- Upon detection of smoke in the CRHAHVS or the CBGAHVS outside air intake, the normal outside air inlet dampers and the exhaust dampers close. Return air is recirculated through the AHU. In the CRHAHVS, only the restroom exhaust air dampers close. With the exhaust flow path closed, the CRHAHVS restroom exhaust fan is stopped manually.
- Upon detection of smoke in the CRHAHVS or the CBGAHVS supply or return air duct the sub-system shuts down and the isolation dampers close. In the CBGAHVS, smoke dampers are provided to prevent smoke and hot gases from migrating into other fire areas. Upon detection of smoke, the smoke dampers will automatically close and isolate the fire area containing the affected division.
- MCR operators manually initiate the smoke purge mode of operation of the CRHAHVS or the CBGAHVS. Fully opening the normal outside air inlet dampers and exhaust air dampers and closing the recirculation dampers accomplish smoke purge. This provides 100% outside airflow. Any closed dampers in the fire area that are required to be open for purging smoke are reopened as part of the smoke purge mode. Area smoke detectors are provided in the CRHA and general areas of the Control Building.

Radiological Event Operation:

- When AC power is available, an outside air high radiation signal automatically starts the EFU fan and opens the normally closed outside air inlet dampers to the EFU. The signal also closes the normal outside inlet dampers to the AHU and closes the exhaust air dampers. All outside air is drawn through an EFU. Return air is routed to both the EFU and the AHU.
- When offsite and onsite AC power is lost (SBO), detection of an outside air high radiation condition initiates an automatic shutdown signal in the CRHAHVS control system. The signal shuts down the supply AHU, the associated return/exhaust fan and sends a closure signal to the redundant CRHA isolation dampers. Due to the SBO event

- Maintains a negative pressure in the building to minimize exfiltration of potentially contaminated air. See Table 9.4-3 for system design pressures.
- Maintains airflow from areas of lower potential for contamination to areas of greater potential for contamination.
- Is provided with redundant active components to increase the reliability, availability, and maintainability of the system.
- Is capable of exhausting smoke, heat and gaseous combustion products in the event of a fire.
- Smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified by the Fire Hazards Analysis.
- Shuts down during radiological accidents and isolates the Fuel Building boundary to prevent uncontrolled releases to the outside atmosphere.
- Provides capability to divert exhaust air to the Reactor Building HVAC Purge Exhaust Filter Unit.
- Provides pool sweep ventilation air over the Spent Fuel Pool surface.
- Is designed such that failure of the system does not compromise or otherwise damage safety-related equipment.
- Is provided with shutoff dampers on the inlet and outlet of fans and AHUs to allow for maintenance.
- Is provided with shutoff valves at the inlet and outlet of cooling and heating coils to allow for maintenance.
- Is provided with access doors for AHUs, fans, filter sections, and duct-mounted dampers to allow for maintenance.
- Is provided with capability for manual control of system fans to facilitate testing and maintenance.
- Maintains its structural integrity after a Safe Shutdown Earthquake.

Relative to the FBHVS, this subsection addresses applicable requirements of General Design Criteria (GDC) 2, 5, 60 and 61. These GDCs are discussed in Standard Review Plan (SRP) 9.4.2 Rev.2, July 1981.

The ESBWR:

- Meets GDC 2, as it relates to meeting the guidance of Regulatory Guide (RG) 1.29. Applicable sections of RG 1.29 are Position C.1 for safety-related portions and Position C.2 for nonsafety-related portions.
- Meets GDC 5, as it relates to shared systems and components important to safety for the Fuel Building isolation dampers.

- Filtered outdoor air is provided at a minimum air exchange rate of two volume changes per hour.
- Smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified by the Fire Hazards Analysis.
- The RWBGA HVAC subsystem limits the release of airborne radioactive particulates to the atmosphere by HEPA filtering of the exhaust air from the building prior to discharge to the atmosphere.
- The exhaust air is monitored for radiation prior to discharge to atmosphere.

9.4.3.2 System Description

Summary Description

The RWBCR HVAC subsystem is a recirculating air conditioning system to provide filtered, heated or cooled, and humidified air to the RWBCR area to maintain the required design ambient conditions and pressurization. The RWBCR consists of two 100% capacity air-handling units and a common outside air intake louver. Each air-handling unit contains prefilters, high efficiency filters, a humidifier, a chilled water cooling coil, a hot water heating coil, and a supply fan section. Conditioned air is supplied to the control room area through ducts, dampers and registers.

The RWBCR HVAC subsystem is capable of once-through operation for smoke removal using a separate 100% capacity exhaust fan.

The RWBGA HVAC subsystem is a once-through air conditioning system to provide filtered and heated or cooled, and humidified air to the RWBGA. The RWBGA HVAC supply consists of two 100% capacity air-handling units connected to a common supply distribution ductwork and a common outside air intake louver. Isolation dampers are provided at the inlet and outlet of each unit. Each air-handling unit contains prefilters, high efficiency filters, a chilled water cooling coil, a hot water heating coil, a humidifier, a centrifugal fan, and an automatic damper.

The RWBGA HVAC subsystem exhaust consists of three 50% capacity filtration trains, each with a medium efficiency prefilter and a HEPA filter, a 50% capacity exhaust fan, and a check valve/backdraft damper. Exhaust capacity is greater than the supply capacity in order to maintain the required RWBGA negative pressure. Each filtration train is connected to a common exhaust collection duct and a common exhaust duct discharging to the plant vent stack.

The RWBGA HVAC exhaust subsystem is capable of once-through operation for smoke removal. The HEPA filters are bypassed in this mode.

Detailed System Description

The RWBHVAC system simplified system diagram is provided in Figure 9.4-7. The system includes the major equipment listed in Table 9.4-7.

The RWBHVAC system equipment is located in the Radwaste Building HVAC Fan and Filter room.

various fan-coil units for local area heating and cooling within the Turbine Building are included in the TBHV system.

9.4.4.1 Design Bases

Safety (10 CFR 50.2) Design Bases

The TBHV system does not perform or ensure any safety-related function, and thus, has no safety design basis.

Power Generation Design Bases

The TBHV system:

- Provides temperature control and air movement control for personnel comfort;
- Optimizes equipment performance by the removal of heat dissipated from plant equipment;
- Provides a sufficient quantity of filtered fresh air for personnel;
- Provides for air movement from areas of lesser potential airborne radioactivity to areas of greater potential airborne radioactivity prior to final exhaust;
- Minimizes the possibility of exhaust air recirculation into the air intake
- Minimizes the escape of potential airborne radioactivity to the outside atmosphere during normal operation by exhausting air, through filters from the areas in which a significant potential for contamination exists;
- Provides capability to exhaust the smoke, heat and gaseous combustion products in event of a fire.
- Smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified by the Fire Hazards Analysis.

Regarding the ESBWR non-safety related TBHV system, this subsection addresses or refers to other DCD locations that address the applicable requirements of the General Design Criteria (GDC) 2, 5 and 60, discussed in Standard Review Plan (SRP) 9.4.4, Rev. 2, July 1981.

The ESBWR:

- Meets GDC 2, as it relates to meeting the guidance of Regulatory Guide 1.29, Position C.2 for non-safety related portions
- Is not applicable to GDC 5, because there are no shared systems and components important to safety in the Turbine Building
- Meets GDC 60, as to the system capability to suitably control release of gaseous radioactive effluents to the environment. The system can direct its exhaust air to the TBHV system filtration units. The TBHV system filtration units are designed, tested and maintained in accordance with Regulatory Guide 1.140.

9.4.6 Reactor Building HVAC System

- The Reactor Building Heating, Ventilation and Air Conditioning Systems (RBHVS) serves the following areas of the Reactor Building:
- The potentially contaminated areas.
- The refueling area.
- The non-radiologically controlled areas.
- The RBHVS does not serve the primary containment except during inerting operations.

9.4.6.1 Design Bases

Safety (10 CFR 50.2) Design Bases

With the following exception, the RBHV System is nonsafety-related. The isolation dampers and ducting penetrating the Reactor Building boundary and associated controls that provide the isolation signal are safety-related. The RBHV System performs no safety-related function except for automatic isolation of the Reactor Building boundary during accidents.

Power Generation Design Bases

The RBHV System:

- Provides a controlled environment for personnel comfort and safety, and for proper operation and integrity of equipment. See Table 9.4-8 for area temperatures maintained.
- Maintains potentially contaminated areas at a negative pressure to minimize exfiltration of potentially contaminated air.
- Maintains clean areas of the building, except for the battery rooms, at a positive pressure to minimize infiltration of outside air.
- Maintains airflow from areas of lower potential for contamination to areas of greater potential for contamination.
- Is provided with redundant active components to increase the reliability, availability, and maintainability of the systems.
- Is capable of exhausting smoke, heat and gaseous combustion products in the event of a fire.
- Prevents smoke and hot gases from migrating into other fire areas by automatically closing smoke dampers upon detection of smoke.
- Smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified in the Fire Hazards Analysis.
- Shuts down during radiological events and isolates the Reactor Building boundary to prevent uncontrolled releases to the outside atmosphere.
- Provides the capability to manually divert exhaust air for processing through the Reactor Building HVAC purge exhaust filter units.
- Provides pool sweep ventilation air over the refueling area pool surface.

- Prevents the buildup of hydrogen in the non-safety related battery rooms to less than 2 percent hydrogen by volume
- Smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified by the Fire Hazards Analysis.

The TSC HVAC subsystem:

- Provides a controlled environment for personal comfort and safety and for the proper operation and integrity of equipment in the TSC
- Maintains the TSC at a slightly positive pressure with respect to the adjacent rooms and outside environment to minimize the infiltration of air. The TSC HVAC subsystem automatically switches to the recirculation mode if toxic gases or smoke are detected in the outside intake air. In this case, there may be no differential pressure between the TSC and the surrounding areas
- Detects and limits the introduction of airborne hazardous materials (radioactivity, smoke, chlorine gas or other site-specific toxic gas) into the TSC
- Removes vitiated air from the kitchen and restrooms
- Redundant components are included to increase the reliability, availability and maintainability of the ventilation system
- The on-site diesel generators provide electrical power to the TSC HVAC subsystem in case of Loss of Preferred Power (LOPP)

The DG HVAC subsystem:

- Provides ventilation air to maintain acceptable temperatures within the generator rooms for equipment operation and reliability during periods of diesel generator operation
- Provides adequate heating and ventilation for suitable environmental conditions for maintenance personnel working in the diesel generator room when the generators are not in operation
- Provides suitable environmental conditions for equipment operation in each diesel generator electrical and electronic equipment area under the various modes of diesel generator operation
- Prevents the accumulation of combustible vapors and dissipate their concentration in the fuel oil day tank room

9.4.7.2 System Description

Summary Description

Figure 9.4-12 shows the EBHV Simplified System Diagram.

The EER HVAC subsystem provides a controlled environment for the Electric Equipment Building switchgear, cable spreading, electronic and non-safety related battery rooms.

9.5 OTHER AUXILIARY SYSTEMS

9.5.1 Fire Protection System

The term "fire protection system" refers to the integrated complex of components and equipment provided for detection, notification, annunciation, and suppression of fires. In addition to this system, the "fire protection program" includes the concepts of design and layout implemented to prevent or mitigate fires, administrative controls and procedures, and the training of personnel to combat fires.

9.5.1.1 Design Bases

Safety (10 CFR 50.2) Design Bases

The Fire Protection System (FPS) does not perform any safety-related function. There is no interface with any safety-related component.

Power Generation Design Bases

In accordance with NUREG-0800 SRP 9.5.1 and Regulatory Guide 1.189, fire protection for nuclear power plants uses the concept of defense in depth to achieve the required degree of reactor safety by using administrative controls, fire protection systems and features, and safe shutdown capability. These defense-in-depth principles achieve the following objectives:

- To prevent fires from starting.
- To rapidly detect, control, and extinguish promptly those fires that do occur.
- To provide protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished by the fire suppression activities does not prevent the safe shutdown of the plant~~.~~ and will not significantly increase the risk of radioactive release to the environment.

The ESBWR fire protection program design bases incorporate the following elements:

- To maintain the ability to safely shut down the reactor and keep it shut down by providing adequate separation of safety-related equipment. This capability is to be achievable during all modes of plant operation.
- To minimize the probability of the spread of fire by the use of fire barriers between areas of significant combustible loading.
- To maintain the ability to minimize the potential for radioactive releases to the environment in the event of a fire.

The ESBWR Fire Protection System (FPS) design bases incorporate the following elements:

- To maintain the ability to safely shut down the reactor and keep it shut down by providing the capability to control the spread of and extinguish the postulated fires in all plant areas by the use of fixed and/or portable fire fighting equipment. This capability is achievable during all modes of plant operation.
- To provide automatic fire detection and annunciation for selected areas of the plant as required by the Fire Hazards Analysis for personnel safety and fire brigade notification.

protection program including the plant design and layout to prevent or mitigate fires and includes administrative controls and procedures.

The type of fire suppression is based on the combustible loading and the extent of safety-related equipment within a fire area. Fixed automatic fire suppression systems are installed in areas identified as having a high fire hazard rating by the Fire Hazards Analysis (FHA) (Appendix 9A). Building standpipes and hose stations are provided in major buildings. Portable fire extinguishers are strategically located throughout the plant in accordance with NFPA 10, except in highly radioactive areas.

~~A comprehensive~~ An automatic fire detection, alarm, supervisory control, and indication system is also provided in selected areas of the plant, as required by the fire hazards analysis for personnel safety and fire brigade notification.~~various locations throughout the plant. The operation of this system is automatic, and is controlled from local panels throughout the plant.~~

A main fire alarm panel (MFAP), is located in the Main Control Room (MCR), monitors and receives system actuation, supervisory, and trouble alarm signals from the individual local panels.

9.5.1.3 Facility Features for Fire Protection

Consistent with applicable safety-related requirements, structures, systems, and components are designed and located to minimize the probability and effect of fires. To the maximum extent practical, noncombustible and fire-resistant materials minimize the combustible loading and thereby reduce the expected duration, severity, and intensity of fires.

Within the safety-related structures, interior walls, partitions, structural components, materials for insulation, and radiation shielding are either noncombustible or have low ratings for contribution. The flame spread and smoke development rating of these materials is 25 or less. Materials having a flame spread and smoke development rating of 50 or more are considered to be combustible when analyzing fire hazards.

Exposed structural steel protecting safety-related areas is fireproofed with material with a fire rating of up to 3 hours as determined from the FHA.

Access stairwells are enclosed in minimum 2-hour rated firewalls and equipped with self-closing fire-rated doors. Openings in fire barriers or firewalls are equipped with fire doors, frames, and hardware rated the same as the barriers they penetrate.

Safety-related raceway and circuit routing comply with Branch Technical Position (BTP) SPLB 9.5-1 except that separation by fire barriers rather than distance is used outside the MCR or primary containment. Exceptions to this requirement are analyzed and justified as acceptable on an individual basis. The acceptance criteria is that a single fire cannot degrade the performance of more than one division of safe shutdown equipment controlled from the main control room. If however, alternate means of control or indication are provided or available that remain unaffected by the same fire, then exception to "the BTP SPLB 9.5-1 requirements for circuit routing and separation" may be taken. The alternate means of control or indications are not required to be safety related. ~~Exceptions to this requirement are analyzed and justified as acceptable on an individual basis.~~ All electrical cables (safety-related and nonsafety-related)

conform to the IEEE 1202 flame test criteria. ~~Safety-related cables conform to the IEEE-383 flame test.~~

The intent is to avoid use of electrical raceway fire barrier systems (ERFBS) for ESBWR, instead relying on divisional separation by fire area and structural fire barriers.

9.5.1.4 Fire Protection Water Supply System

Water Source

Water for the Fire Protection System is supplied from a minimum of two reliable sources. Each source has sufficient capacity to meet the maximum water demand of the system for a period of two hours. Water sources that are used for multiple purposes ensure that the required quantity of water is dedicated for fire protection use only.

Fire department connections on all major buildings allow a fire department pumper truck to pump water into the FPS as an additional fire protection water supply source.

Fire Pumps

Each of the three 50% capacity firewater pumps provides 100% of the firewater demand to the worst-case fire within the nuclear island (Reactor Building, Fuel Building, and Control Building) or 50% of the firewater demand to the worst-case fire within the balance of plant. The pumps are capable of delivering the flow and pressure required to the location that is farthest from the firewater supply source. Two of the three pumps are located near the nuclear island power block in a fire pump enclosure (FPE). The third pump is located remote from the other two pumps to avoid any common-location failures.

For the two nuclear island fire pumps, the lead pump is motor-driven and the backup pump is diesel-driven. The backup pump provides firewater in the event of failure of the motor-driven pump or loss of preferred power (LOPP). A motor-driven jockey pump maintains the system pressure to minimize the cycling of the main fire pumps due to minor pressure losses.

The main diesel-driven fire pump, including its suction and discharge piping, meets the requirements of ASME B31.1 and remains functional after an SSE. The diesel-driven fire pump is located in a separate fire-rated compartment from the motor-driven fire pump.

The second diesel-driven fire pump provides a back up to the other two pumps. This back-up diesel-driven fire pump may be new or existing and is connected to the main yard piping loop.

The fuel oil tanks for the diesel-driven fire pumps have a capacity sufficient to allow operation of the diesel engines for approximately 8 hours before refilling based upon the fuel consumption and margin criteria provided in NFPA 24.

9.5.1.5 Fire Water Supply Piping, Yard Piping, and Yard Hydrants

The fire water supply piping consists of a non-seismic, buried yard main and a suspended ASME B31.1 piping loop. The ASME B31.1 piping loop supplies firewater to the nuclear island buildings and remains functional following an SSE. The main firewater pumps discharge to the ASME B31.1 piping loop. A connection from the ASME B31.1 piping loop supplies firewater to the yard main. The second diesel-driven fire pump supplies firewater directly to the yard main, but is also capable of supplying water to the ASME B31.1 piping loop. Motor-operated isolation

Preaction fire detection systems have 90-hour (minimum) backup battery packs located at the local fire alarm panel (releasing panel). Other fire detection and alarm systems have 24-hour (minimum) backup battery packs located at each local fire alarm panel (supervisory panel) and at the MFAP.

Manual fire alarm stations (pull box stations) are provided at the normal exit paths or every 61 meters (200 feet), whichever is less, throughout normally occupied buildings. Manual fire alarm stations (pull box stations) are provided at normal exit paths only for normally unoccupied buildings. Visible fire notification is provided in manned office areas such as in the Control Building and the Service Building.

9.5.1.10 Fire Barriers

Fire barriers of 3-hour fire resistance rating are provided separating:

- Safety-related systems from any potential fires in nonsafety-related areas that could affect the ability of safety-related systems to perform their safety function.
- Redundant divisions or trains of safety-related systems from each other to prevent damage from a single fire.
- Components within a single safety-related electrical division that present a fire hazard to components in another safety-related division.

Penetrations through fire barriers are sealed or closed to provide fire resistance ratings at least equal to that of the barrier. Only noncombustible materials qualified per ASTM E-119 are used for construction of fire barriers. Fire dampers protect ventilation duct openings in fire barriers as required by NFPA 90A.

9.5.1.11 Building Ventilation

Smoke control in accordance with NFPA 92A is provided for unsprinklered areas where a potential for heavy smoke or heat conditions are identified by the Fire Hazards Analysis.

Fire protection/smoke control provisions for ventilation for the various building areas are designed as follows:

Control Building (CB) Smoke Removal

The CB HVAC System (CBHVS) provides smoke removal through two CBHVS sub-systems: Control Room Habitability Sub-system (CRHAHVS) and Control Building General Area HVAC Sub-system (CBGAHVS). Fire-rated penetration seals, and smoke dampers are provided to prevent smoke and hot gases from migrating into other fire areas.

Control Room Habitability Area Sub-system (CRHAHVS)

The MCR is separated from the rest of the Control Building by a 1-hour fire barrier and separated from other major plant areas by 3-hour fire barriers.

Manual fire fighting capability in the MCR consists of portable dry Class ABC chemical fire extinguishers. Additionally, hose stations with UL-approved fixed fog nozzles are installed outside both entrances to the MCR. No hose stations are located within the MCR.

Guidance — "In addition, it should be demonstrated that smoke, hot gases, or the fire suppressant does not migrate into other fire areas to the extent that safe shutdown capabilities, including operator actions, could be adversely affected."

Conformance — The ESBWR fire protection design satisfies this guidance with a combination of fire dampers and other barriers, smoke evacuation capabilities, and minimal required operator actions. Details are provided in the 9.5.1.2.9.

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, unless identified as a significant fire hazard by the Fire Hazard Analysis.

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, unless identified as a significant fire hazard by the Fire Hazard Analysis.

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, unless identified as a significant fire hazard by the Fire Hazard Analysis.

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.

Table 9.5-2

FPS Component Design Characteristics

Fire Water Pumps	
Motor-driven fire pump	454.2 m^3/hr (2,000 gpm)***
Primary diesel-driven fire pump	454.2 m^3/hr (2,000 gpm)***
Secondary diesel-driven fire pump*	454.2 m^3/hr (2,000 gpm)***
Motor-driven jockey pump	4.54 m^3/hr (20 gpm) minimum as required to maintain the fire water main pressure 68.8 kPa (10 psi) above the start pressure of the fire pumps
Fire Water Storage Tanks	
Primary storage tank minimum fire water storage	2081.8 m^3 (550,000 gallons)
Secondary storage minimum fire water storage**	2081.8 m^3 (550,000 gallons)

* Secondary diesel-driven fire pump may be new or existing depending upon available site-specific provisions.

** Secondary fire water storage may be a tank, cooling tower basin, or a large body of water depending upon available site-specific provisions. Storage volume listed is the minimum storage volume to be dedicated for fire protection use.

*** Based on the largest firewater demand of 4256 gpm for Turbine Building, including hose stream.

(15) The design of the water supply system ensures delivery of water to the standpipe and hose rack systems concurrent with a single active failure. The standpipe system and one diesel driven fire pump, its water supply, its suction piping, and its discharge piping throughout the Reactor, Fuel, and Control Buildings are designed to remain functional following an SSE. The standpipes which supply fire water to hose stations covering safety-related equipment are contained within the concrete stairwells or dedicated concrete chases, and thus, are protected from other phenomena of less severity and greater frequency.~~The design of the water supply system ensures delivery of water to the standpipe and hose rack systems concurrent with a single active failure. The standpipe system and one diesel driven fire pump, its water supply, its suction piping, and its discharge piping throughout the Reactor, Fuel, and Control Buildings are designed to remain functional following an Safe Shutdown Earthquake (SSE). The standpipes are contained within the building, and thus, are protected from other phenomena of less severity and greater frequency.~~

(16) The effect of pipe breaks in fire suppression systems and protection methods for the effect of pipe breaks meet the criteria specified in Section 3.4 and Subsection 9.5.1.~~The effect of pipe breaks in fire suppression systems and protection methods for the effect of pipe breaks meet the criteria specified in Section 3.4 and Subsection 9.5.1.~~

(17) The floor drains are sized to handle both leakage from a crack in the standpipes or simultaneous operation of two fire hose streams. See Subsection 9.3.3 for details of the plant drainage system.~~The floor drains are sized to handle both a leakage from a crack in the standpipes or from two fire hose streams. See Subsection 9.3.3 for details of the plant drainage system.~~

(18) Piping and cable tray penetrations are provided with fire-stops when penetrating fire rated barriers.~~Piping and cable tray penetrations are provided with fire-stops when penetrating fire rated barriers.~~

(19) HVAC penetrations through 2-hour or 3-hour rated fire barriers are provided with fire dampers compatible with the rating of the fire barrier.~~HVAC penetrations through 2-hour or 3-hour rated fire barriers are provided with fire dampers compatible with the rating of the fire barrier.~~ S

(20) Spill control is provided to contain the contents of any above grade oil-filled vessel or tank larger than 55 gallon and all tanks containing chemicals used in water/wastewater treatment or quality control.

In accordance with NFPA 804, 2001 Edition and RG 1.189, April 2001, the following design criteria is used for containment sizing:

Drainage and any associated drainage facilities for a given area is sized to accommodate the volume of liquid produced by all the following:

(1) The spill of the largest single container of any flammable or combustible liquids in the area.

(2) Where automatic suppression is provided throughout, the credible volume of discharge (as determined by the fire hazard analysis) for the suppression systems operating for a period of 30 minutes.

(3) Where automatic suppression is not provided throughout, the contents of piping systems and containers that are subject to failure in a fire.

(4) Where the installation is outside, credible environment factors such as rain and snow.

(5) Where automatic suppression is not provided throughout, the volume shall be based on a manual fire-fighting flow rate of 500 gal/min (1892.5 L/min) for duration of 30 minutes, unless the fire hazards analysis demonstrates a different flow rate and duration.

9A.2.5 Systems Required to Achieve Safe Shutdown in the Event of Fire ~~Systems Required in the Case of Fire to Achieve Safe Shutdown Systems~~

In case of a design basis fire, certain systems may be required when the Nuclear Steam Supply System (NSSS) is isolated from the main condenser during shutdown or accident conditions.

The main steam lines and feedwater lines provide the core-cooling path to and from the main condenser during normal operation at power or during startup or shutdown transients when the reactor is not isolated.

~~In case of fire, certain The safe shutdown systems may be required when the Nuclear Steam Supply System (NSSS) is isolated from the main condenser during shutdown or accident conditions.~~

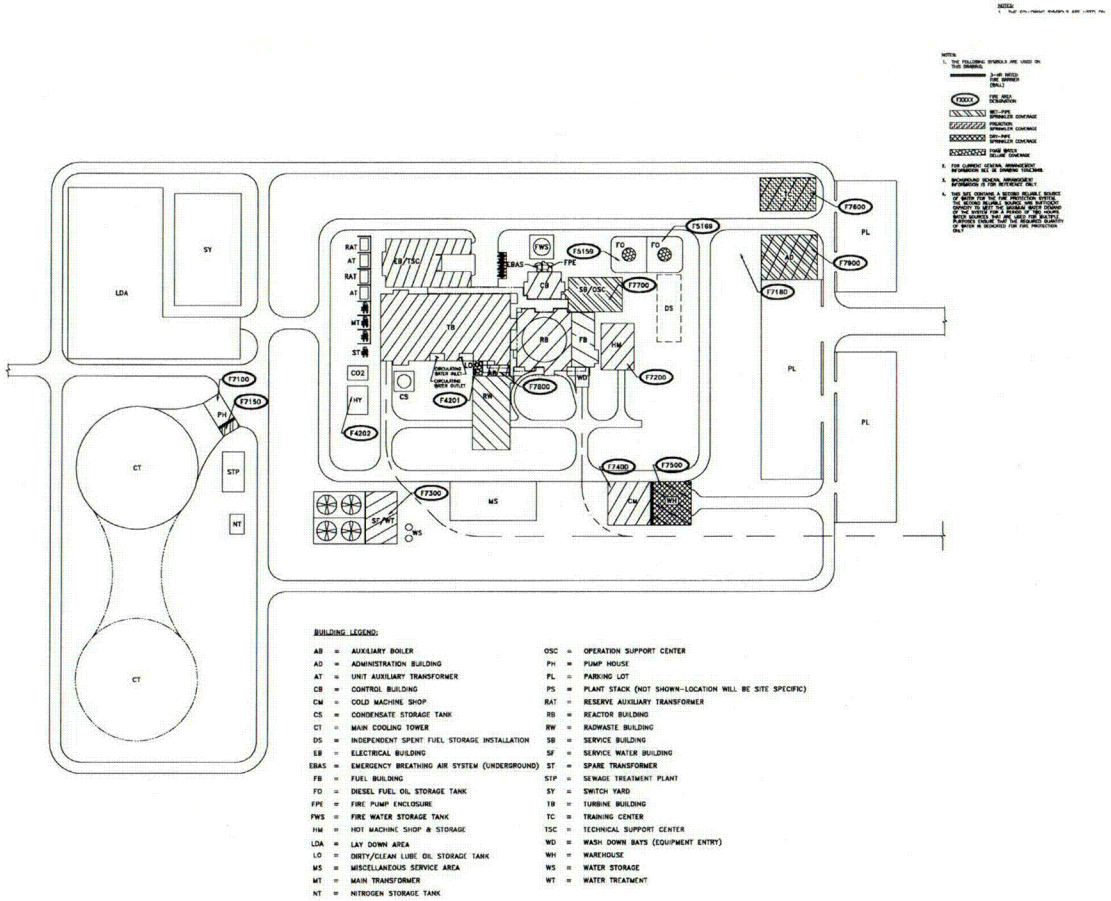
~~The main steam lines and feedwater lines provide the core-cooling path to and from the main condenser during normal operation at power or during startup or shutdown transients when the reactor is not isolated.~~

The safe shutdown functions are accomplished through interaction of various passive safety-related systems. The safe shutdown systems provide one or more of the following functions:

~~In case of fire, tThe safe shutdown functions are accomplished through interaction of various passive safety-related systems. The safe shutdown systems provide one or more of the following functions:~~

- Maintenance of reactor vessel water level;
- Pressure control and/or depressurization of the reactor pressure vessel;
- Heat removal;
- Heat sink;
- DC electrical power; and
- Indication and control.

- ~~Indication and control.Maintenance of reactor vessel water level;~~
- ~~Pressure control and/or depressurization of the reactor pressure vessel;~~
- ~~Heat removal;~~
- ~~Heat sink;~~



BUILDING LEGEND:

AB	= AUXILIARY BOILER	OSC	= OPERATION SUPPORT CENTER
AD	= ADMINISTRATION BUILDING	PH	= PUMP HOUSE
AT	= UNIT AUXILIARY TRANSFORMER	PL	= PARKING LOT
CB	= CONTROL BUILDING	PS	= PLANT STACK (NOT SHOWN-LOCATION WILL BE SITE SPECIFIC)
CM	= COLD MACHINE SHOP	RAT	= RESERVE AUXILIARY TRANSFORMER
CS	= CONDENSATE STORAGE TANK	RB	= REACTOR BUILDING
CT	= MAIN COOLING TOWER	RW	= RADWASTE BUILDING
DS	= INDEPENDENT SPENT FUEL STORAGE INSTALLATION	SB	= SERVICE BUILDING
EB	= ELECTRICAL BUILDING	SF	= SERVICE WATER BUILDING
EBAS	= EMERGENCY BREATHING AIR SYSTEM (UNDERGROUND)	ST	= SPARE TRANSFORMER
FB	= FUEL BUILDING	STP	= SEWAGE TREATMENT PLANT
FD	= DIESEL FUEL OIL STORAGE TANK	SY	= SWITCH YARD
FPE	= FIRE PUMP ENCLOSURE	TB	= TURBINE BUILDING
FWS	= FIRE WATER STORAGE TANK	TC	= TRAINING CENTER
HM	= HOT MACHINE SHOP & STORAGE	TSC	= TECHNICAL SUPPORT CENTER
LDA	= LAY DOWN AREA	WD	= WASH DOWN BAYS (EQUIPMENT ENTRY)
LO	= DIRTY/CLEAN LUBE OIL STORAGE TANK	WH	= WAREHOUSE
MS	= MISCELLANEOUS SERVICE AREA	WS	= WATER STORAGE
MT	= MAIN TRANSFORMER	WT	= WATER TREATMENT
NT	= NITROGEN STORAGE TANK		

Figure 9A.2-33. Site Fire Protection Zone ESBWR DCD Plot Plan

Table 9A.5-1, Reactor Building (Cont.)

Fire Area:	**F1170**
Building:	**Reactor**
description:	**Drywell and Containment**
applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 14, 72, 101, 804**
building code occupancy classification:	**F-1**
electrical classification:	**none**
safety-related divisional equipment or cables:	**I, II, III, IV**
nonsafety-related redundant trains or equipment or cables:	**A, B**
surrounded by fire barriers rated at:	**3 hours**
except:	**basemat (non-rated), including basaltic concrete**

DCD Fig:

9A.2-1	**9A.2-6**
9A.2-2	**9A.2-7**
9A.2-3	**9A.2-8**
9A.2-4	**9A.2-9**
9A.2-5	

consisting of the following Rooms:

EL	Room #	Potential Combustibl	Fire Detection		Fire Suppression	
			Primary	Backup	Primary	Backup
-8800	**1170**	**Class IIIB lubricants Cable insulation Filter media**	**None**	**Portable fire detection used as needed during outage activities**	**Inerted environment during power operation**	**Hose racks and ABC fire extinguishers (via hatches at EL -6400, EL 13570, and EL 17500~~, and EL 34000~~) (extra fire hose and fire extinguishers stageed at hatches as required)**
-6400	**1206**					
4650	**14P0**					
9060	**1570**					
17500	**17P0, 17P1, 17P2**	**None**				
27000	**18P3A, 18P3B, 18P4A, 18P4B, 18P4C, 18P5A, 18P5B, 18P5C 18P3C, 18P3D, 18P4D, 18P4E, 18P4F, 18P6A, 18P6B, 18P6C**					

< 700	Anticipated combustible load, MJ/m2
700	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**Reactor scram; outage required to restore**
Radiological release:	**Contained within containment structure**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via hatches**
Property loss:	**Significant**

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

During plant operation, this entire Fire Area is inerted by nitrogen and will not support combustion. When not inerted (during shutdowns and outages), complete burnout of all equipment and cables within this Fire Area is prevented by limited amount of combustibles and spatial separation between redundant divisional circuits to ensure that no more that two divisions of safe shutdown equipment will be affected by a single fire. See also section 9A.6.

Table 9A.5-1, Reactor Building (Cont.)

Fire Area:	**F1210**	description:	**Division I Battery**			
Building:	**Reactor**	applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 14, 72, 101, 804**			
DCD Fig:	**9A.2-2** **9A.2-3**	building code occupancy classification:	**F-1 per IBC 307.9.11**			
		electrical classification:	**none**			
		safety-related divisional equipment or cables:	**I**			
		contains nonsafety-related redundant trains or equipment or cables:	**none**			
		surrounded by fire barriers rated at:	**3 hours**			
		except:	**elevator doors (1.5 hr rated)**			

consisting of the following Rooms:			Fire Detection		Fire Suppression	
EL	Room #	Potential Combustibles and Hazards	Primary	Backup	Primary	Backup
-6400	**1210**	**12,360 L of battery acid** **Battery cell cases** **Cable insulation**	**Area-wide ionization**	**Manual pulls (outside stairwell)**	**CO2 fire extinguishers**	**Hose racks (in nearby stairwell)**

< 1400	Anticipated combustible load, MJ/m2
1400	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**None**
Radiological release:	**None, no radiological materials present**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via stairwell and interior doors**
Property loss:	**Moderate**

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area results in loss of only Safety Division I equipment; remaining three Safety Divisions and both redundant A and B equipment are unaffected by fire and are operable. Automatic logic control scheme (any two out of four redundant signals) remains operable. Battery exhaust fans are alarmed to MCR.

Table 9A.5-1, Reactor Building (Cont.)

Fire Area:	**F1220**
Building:	**Reactor**
DCD Fig:	**9A.2-2** **9A.2-3**
description:	**Division II Battery**
applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 14, 72, 101, 804**
building code occupancy classification:	**F-1 per IBC 307.9.11**
electrical classification:	**none**
safety-related divisional equipment or cables:	**II**
contains nonsafety-related redundant trains or equipment or cables:	**none**
surrounded by fire barriers rated at:	**3 hours**
except:	**elevator doors (1.5 hr rated)**

consisting of the following Rooms:			Fire Detection		Fire Suppression	
EL	Room #	Potential Combustibles and Hazards	Primary	Backup	Primary	Backup
-6400	**1220**	**12,360 L of battery acid** **Battery cell cases** **Cable insulation**	**Area-wide ionization**	**Manual pulls (outside stairwell)**	**CO2 fire extinguishers**	**Hose racks (in nearby stairwell)**

< 1400	Anticipated combustible load, MJ/m2
1400	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**None**
Radiological release:	**None, no radiological materials present**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via stairwell and interior doors**
Property loss:	**Moderate**

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area results in loss of only Safety Division II equipment; remaining three Safety Divisions and both redundant A and B equipment are unaffected by fire and are operable. Automatic logic control scheme (any two out of four redundant signals) remains operable. Battery exhaust fans are alarmed to MCR.

Table 9A.5-1, Reactor Building (Cont.)

Fire Area:	**F1230**	description:	**Division III Battery**
Building:	**Reactor**	applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 14, 72, 101, 804**
DCD Fig:	**9A.2-2** **9A.2-3**	building code occupancy classification:	**F-1 per IBC 307.9.11**
		electrical classification:	**none**
		safety-related divisional equipment or cables:	**III**
		contains nonsafety-related redundant trains or equipment or cables:	**none**
		surrounded by fire barriers rated at:	**3 hours**
		except:	**none**

consisting of the following Rooms:			Fire Detection		Fire Suppression	
EL	Room #	Potential Combustibles and Hazards	Primary	Backup	Primary	Backup
-6400	**1230**	**6840 L of battery acid** **Battery cell cases** **Cable insulation**	**Area-wide ionization**	**Manual pulls (outside stairwell)**	**CO2 fire extinguishers**	**Hose racks (in nearby stairwell)**

< 1400	Anticipated combustible load, MJ/m2
1400	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**None**
Radiological release:	**None, no radiological materials present**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via stairwell and interior doors**
Property loss:	**Moderate**

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area results in loss of only Safety Division III equipment; remaining three Safety Divisions and both redundant A and B equipment are unaffected by fire and are operable. Automatic logic control scheme (any two out of four redundant signals) remains operable. Battery exhaust fans are alarmed to MCR.

Table 9A.5-1, Reactor Building (Cont.)

Fire Area:	**F1240**	description:	**Division IV Battery**
Building:	**Reactor**	applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 14, 72, 101, 804**
DCD Fig:	**9A.2-2** **9A.2-3**	building code occupancy classification:	**F-1 per IBC 307.9.11**
		electrical classification:	**none**
		safety-related divisional equipment or cables:	**IV**
		contains nonsafety-related redundant trains or equipment or cables:	**none**
		surrounded by fire barriers rated at:	**3 hours**
		except:	**none**

consisting of the following Rooms:			Fire Detection		Fire Suppression	
EL	Room #	Potential Combustibles and Hazards	Primary	Backup	Primary	Backup
-6400	**1240**	**6840 L of battery acid** **Battery cell cases** **Cable insulation**	**Area-wide ionization**	**Manual pulls (outside stairwell)**	**CO2 fire extinguishers**	**Hose racks (in nearby stairwell)**

< 1400	Anticipated combustible load, MJ/m2
1400	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**None**
Radiological release:	**None, no radiological materials present**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via stairwell and interior doors**
Property loss:	**Moderate**

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area results in loss of only Safety Division IV equipment; remaining three Safety Divisions and both redundant A and B equipment are unaffected by fire and are operable. Automatic logic control scheme (any two out of four redundant signals) remains operable. Battery exhaust fans are alarmed to MCR.

Table 9A.5-1, Reactor Building (Cont.)

Fire Area:	**F1450**
Building:	**Reactor**
DCD Fig:	**9A.2-4**
description:	**Hydrogen Gas A**
applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 24, 50A, 72, 101, 497, 804**
building code occupancy classification:	**F-1**
electrical classification:	**Group B Class I Div II**
safety-related divisional equipment or cables:	**none**
contains nonsafety-related redundant trains or equipment or cables:	**A**
surrounded by fire barriers rated at:	**3 hours**
except:	**basemat (non-rated)**

consisting of the following Rooms:			Fire Detection		Fire Suppression	
EL	Room #	Potential Combustibles	Primary	Backup	Primary	Backup
4650	**1450**	**Electrical equipment Cable insulation 16 m3 Hydrogen**	**Area-wide spot heat**	**Manual pull (outside room)**	**ABC fire extinguisher**	**Hydrant**

< 700	Anticipated combustible load, MJ/m2
700	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**None**
Radiological release:	**None, no radiological materials present**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via door**
Property loss:	**Minor**

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area affects only redundant train A equipment and no Safety Related equipment; all Safety Divisions and redundant train B are operable. Both A and B on-site power sources are unaffected by fire and are operable. Potential for hydrogen buildup is mitigated by louvers in the top and bottom of the 3-hr fire rated exterior wall. Ignition within is prevented by requiring all electrical devices to be rated NEC Group B Class I Division II. In the event of an ignition and explosion, damage to the Reactor Building or Control Building is prevented by 3-hr fire rated reinforced concrete walls that are approximately 1.5 meters thick for the nearby Reactor Building and approximately 0.7 meters thick for the Control Building which is further away. Damage ot the redundant hydrogen systems is prevented by physically separating them by over 50 meters and surrounding each by 3-hr fire rated concrete walls, including penetration seals and doors.

Table 9A.5-1, Reactor Building (Cont.)

Fire Area:	**F1460**
Building:	**Reactor**
DCD Fig:	**9A.2-4**
description:	**Hydrogen Gas B**
applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 24, 50A, 72, 101, 497, 804**
building code occupancy classification:	**F-1**
electrical classification:	**Group B Class I Div II**
safety-related divisional equipment or cables:	**none**
contains nonsafety-related redundant trains or equipment or cables:	**B**
surrounded by fire barriers rated at:	**3 hours**
except:	**basemat**

consisting of the following Rooms:			Fire Detection		Fire Suppression	
EL	Room #	Potential Combustibles	Primary	Backup	Primary	Backup
4650	**1460**	**Electrical equipment Cable insulation 16 m3 Hydrogen**	**Area-wide spot heat**	**Manual pull (outside room)**	**ABC fire extinguisher**	**Hydrant**

< 700	Anticipated combustible load, MJ/m2
700	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**None**
Radiological release:	**None, no radiological materials present**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via door**
Property loss:	**Minor**

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area affects only redundant train B equipment and no Safety Related equipment; all Safety Divisions and redundant train A are operable. Both A and B on-site power sources are unaffected by fire and are operable. Potential for hydrogen buildup is mitigated by louvers in the top and bottom of the 3-hr fire rated exterior wall. Ignition within is prevented by requiring all electrical devices to be rated NEC Group B Class I Division II. In the event of an ignition and explosion, damage to the Reactor Building or Control Building is prevented by 3-hr fire rated reinforced concrete walls that are approximately 1.5 meters thick for the nearby Reactor Building and approximately 0.7 meters thick for the Control Building which is further away. Damage ot the redundant hydrogen systems is prevented by physically separating them by over 50 meters and surrounding each by 3-hr fire rated concrete walls, including penetration seals and doors.

Table 9A.5-3, Control Building (cont.)

Fire Area:	F3270	description:	Main Control Room Complex
Building:	Control	applicable codes:	IBC; Reg Guide 1.189; NFPA 10, 14, 72, 75, 101, 804
DCD Fig:	9A.2-3 9A.2-4	building code occupancy classification:	B
		electrical classification:	none
		safety-related divisional equipment or cables:	I, II, III, IV
		nonsafety-related redundant trains or equipment or cables:	none
		surrounded by fire barriers rated at:	3 hours
		interior fire barriers rated at:	1 hour, around room 3275 Main Control Room

consisting of the following Rooms:			Fire Detection		Fire Suppression	
EL	Room #	Potential Combustibles	Primary	Backup	Primary	Backup
-2000	below access floor	Cable insulation	Area-wide ionization	Manual pulls (outside stairwells at each landing)	CO2 fire extinguishers	Hose racks (in nearby stairwells)
	3274	Cable insulation				
	3276	Class A combustibles				
-1400	3275	Cable insulation				
	3270	Electrical equipment			Hose racks (in nearby stairwells)	ABC fire extinguishers
	3271	Class A combustibles				
	3273	Filter media				
	3274	Class IIIA lubricants				
	3204, 3205					
	3201, 3202	Class A combustibles	Area-wide photoelectric			
	above ceiling	Insulation	Area-wide ionization			

< 1400	Anticipated combustible load, MJ/m2
1400	Unsprinklered combustible load limit, MJ/m2

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	Reactor scram; turbine trip; outage required to restore
Radiological release:	None, no radiological materials present
Life safety:	Travel distance limits to EXITs meet NFPA 101
Manual firefighting:	Access via stairwells
Property loss:	Significant

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area affects MCR control of all four divisions of safe shutdown equipment. Operators manually scram reactor before evacuating MCR. Reactor and safe shutdown control transferred to either Remote Shutdown Panel (located in separate fire areas F1313 and F1323). All safety-related circuits and train A and B redundant circuits are optically isolated outside this fire area, so all safety divisional equipment both redundant trains A and B are operable. See also section 9A.6.

Table 9A5-4, Turbine Building (Cont.)

Fire Area:	**F4100 (continued)**
Building:	**Turbine**
DCD Fig:	**9A.2-12** **9A.2-13** **9A.2-14** **9A.2-15** **9A.2-16** **9A.2-17**
description:	**Turbine Equipment (continued)**
applicable codes:	**IBC; Reg Guide 1.189; NFPA 10, 12, 13, 14, 15, 72, 90A, 497, 101, 804**
building code occupancy classification:	**F-1**
electrical classification:	**none**
safety-related divisional equipment or cables:	**I, II, III, IV**
nonsafety-related redundant trains or equipment or cables:	**none**
surrounded by fire barriers rated at:	**3 hours**
except:	**basemat (non-rated); elevator doors (1.5 hr rated); exterior underground walls (non-rated); exterior walls above EL 12000 (non-rated)**

> 700 in rooms where turbine oil can flow **< 700 in all other rooms**	Anticipated combustible load, MJ/m2
700	Unsprinklered combustible load limit, MJ/m2

Assuming automatic & manual FP equipment does not function, impact of design basis fire on safe shutdown:

Complete burnout of all equipment and cables within this Fire Area affects no safety-related or safe shutdown divisional equipment; all safety divisions and both redundant trains A and B are operable. Fire-related failure of safety-related instrumentaion may cause reactor scram or containment isolation. See Sections ~~9A.6.4.1 and~~ 9A.6.4.2, 9A.6.4.3, 9A.6.4.5, and 9A.6.4.13.

Assuming operation of installed fire extinguishing equipment, impact of fire upon:

Plant operation:	**Turbine trip; restoration required prior to restart**
Radiological release:	**Contained within building**
Life safety:	**Travel distance limits to EXITs meet NFPA 101**
Manual firefighting:	**Access via stairwells**
Property loss:	**Significant**

Remote Shutdown System. Operators can evacuate the Main Control Room after scramming the reactor. The Safety System and Logic Control (SSLC) automatically actuates the safety systems. The postulated fire assumes loss of all component functions ~~in~~ within the Main Control Room, and spurious actuations are considered in the analysis. In order to cool the plant down, the operators can control the nonsafety-related systems from either Remote Shutdown System (RSS) panel, located in separate fire areas within the Reactor Building~~All four divisions are present in the Main Control Room. In the event of a fire the Main Control Room is evacuated and plant shutdown is controlled from the independent divisionally separated Remote Shutdown System. Operators can evacuate the Main Control Room after scramming the reactor. The Safety System and Logic Control (SSLC) automatically actuates the safety systems. The postulated fire assumes loss of all component functions in within the Main Control Room, and spurious actuations are considered in the analysis. In order to cool the plant down, the operators can control the nonsafety-related systems from either Remote Shutdown System (RSS) panel, located in separate fire areas within the Reactor Building~~.

9A.6.4.13 Safety-Related Instrumentation in Turbine Buildings

Safety-related devices within the Turbine Building are limited to the instrumentation listed in the Table 9A.6-1.

The safety-related RPS input devices listed in the table provide a monitoring function of the measured parameter. The safety-related RPS output devices listed in the table receive a signal from the RPS to initiate an anticipatory trip of the Feedwater Pumps. The devices listed in the Table 9A.6-1 are provided for DCD Tier 2, Chapter 15, Analysis of Anticipated Operating Occurrences, and DCD Tier 2, Chapter 15, Analysis of Infrequent Events, and do not perform a safe-shutdown function in the event of a fire.

The cables associated with these devices will be routed in individual raceway specific to their associated division, and will be separated in accordance with IEEE 384 criteria and Subsection 8.3.1.4.1. Since these devices and their associated cables do not perform a safe shutdown function, complete burnout of all of these devices and their associated cables within their fire area does not affect the ability to achieve and maintain post-fire safe-shutdown, as shown in the Table 9A.6-1.

9A.6.5 Comparison to BTP SBLP 9.5-1 and Regulatory Guide 1.189

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

9A.6.5.1 No Fire Detection within Electrical Cabinets in Main Control Room Complex

Section 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."[f76][f77]

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

Table 9A.6-1

Turbine and Electrical Building Safety-related Monitoring Devices

Parameter Description	RPS Input or Output	Parameter Measuring or Actuating Device	Building	Room	Divisions	Total Burnout Impact With No Hot Short	Total Burnout Impact With Hot Short
Condenser Vacuum	Input	Transmitter (Analog signal between upper and lower limits)	TB	4392	I, II, III, IV	Indication to RPS of Loss of Condenser Vacuum; Refer to Subsection 15.2.2.8	Indication to RPS of Loss of Condenser Vacuum; Refer to Subsection 15.2.2.8
Main Steam Line Pressure	Input	Transmitter (Analog signal between upper and lower limits)	TB	4390	I, II, III, IV	Indication to RPS of Closure of All Main Steamline Isolation Valves; Refer to Subsection 15.2.2.7	Indication to RPS of Closure of All Main Steamline Isolation Valves; Refer to Subsection 15.2.2.7
Turbine Bypass Valve Position	Input	Position Switch	TB	4391 and 4392	I, II, III, IV	Indication to RPS of Turbine Bypass Valves Opening; Refer to Subsection 15.3.3.1	Loss of RPS Ability to Monitor Turbine Bypass Valve Position
Turbine Stop Valve Position	Input	Position Switch	TB	4380	I, II, III, IV	Indication to RPS of Turbine Stop Valves Closing; Refer to Subsections 15.3.6.1	Loss of RPS Ability to Monitor Turbine Stop Valve Position
Turbine Control Valve Position	Input	Transmitter (Analog signal between upper and lower limits)	TB	4506 and 4507	I, II, III, IV	Indication to RPS of Turbine Control Valves Closing; Refer to Subsection 15.3.4.1	Indication to RPS of Turbine Control Valves Closing; Refer to Subsection 15.3.4.1
Turbine Area Temperatures (Main Steam Leak Detection)	Input	Temperature Elements (Analog signal between upper and lower limits)	TB	4390 and 4393	I, II, III, IV	Indication to RPS of Main Steamline Leak; Refer to Subsections 9A.6.4.2 and 15.2.2.7	Indication to RPS of Main Steamline Leak; Refer to Subsections 9A.6.4.2 and 15.2.2.7

Table 9A.6-1

Turbine and Electrical Building Safety-related Monitoring Devices (continued)

Parameter Description	RPS Input or Output	Parameter Measuring or Actuating Device	Building	Room	Divisions	Total Burnout Impact With No Hot Short	Total Burnout Impact With Hot Short
Safety-Related Feedwater Pump Breaker Trip	Output	Breaker Trip Coils	TB	4102	I, II	Loss of RPS Ability to Trip Feedwater Pumps	Trip of all Feedwater Pump Breakers Resulting in Loss of Feedwater Flow; Refer to Subsection 15.2.5.3
Safety Related Feedwater Pump Breaker DC Control Power	N/A	Breaker Trip Coils	TB	4102	I, II	Loss of RPS Ability to Trip Feedwater Pumps	Loss of RPS Ability to Trip Feedwater Pumps
Feedwater Line Diff. Pressure (Indication of Feedwater Pump Runout)	Input	Transmitter (Analog signal between upper and lower limits)	TB	4293	I, II, III, IV	Indication to RPS of Feedwater Pump Runout; Refer to Subsection 15.2.4.2	Indication to RPS of Feedwater Pump Runout; Refer to Subsection 15.2.4.2