GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

February 11, 1994 Docket No. 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: Submittal Supporting Accelerated ABWR Schedule - **Response to Open Item F14.3.2-1**

Dear Chet:

Enclosed are CDM and SSAR markups addressing the subject open item pertaining to ACRS concerns on fires and floods, including Mr. Michelson's tunnel-related issues.

Please provide a copy of this transmittal to Tom Boyce, Butch Burton and Jim Lyons.

Sincerely,

A. J. James
Advanced Reactor Programs

cc:
Alan Beard (GE)
Medhat El-Zeftawy (ACRS)
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ABWR DESIGN CERTIFICATION

NRC FSER OPEN ITEM NO. 14.3.2-1
GE CLOSURE PROPOSAL

CONTENTS

NRC ABWR FSER

OPEN ITEM 14.3.2-1

TEXT

The staff is evaluating ACRS comments regarding the need for verification of fires and flooding analyses in the ITAAC for buildings. This is Open Item F14.3.2-1.

(PROPOSED CHANGES TO REFLECT ACRS CONCERNS)

2.15.6 Fire Protection System

Design Description

The Fire Protection System (FPS) detects, alarms and extinguishes fires. Fire detection and alarm systems are provided in all fire areas. The FPS consists of a motor driven pump, a diesel drive pump, sprinkler systems, standpipes and hose reels, and portable extinguishers. The foam systems are also used for special applications. The basic configuration of the FPS water supply system is shown on Figure 2.15.6. The FPS provides fire protection for the Reactor Building, Control Building, Turbine Building, Radwaste Building, and other plant buildings.

Areas covered by sprinklers or foam systems are also covered by the manual hose system. Areas covered only by manual hoses can be reached from at least two hose stations. A hose reel and fire extinguisher are located no greater than 30.5m from any location within the buildings.

The FPS is classified as non-safety-related. The sprinkler systems and the standpipe systems in the Reactor and Control Buildings and portions of the FPS water supply system identified in Figure 2.15.6 remain functional following a safe shutdown earthquake (SSE). These portions of the water supply are separated from the remainder of the system by valves as shown in Figure 2.15.6.

Fresh water is used for the water supply system. Two sources with a minimum capacity of 1140 m^3 for each source are provided. A minimum of 456 m^3 is reserved for use by the portion of the suppression system used for the Reactor and Control Buildings. Both the diesel driven pump and motor driven pump independently supply a minimum flow of 1890 liters/min at a pressure greater than 4.57 kg/cm^2g at the most hydraulically remote hose connection. The two fire water pumps provide 5670 liters/min flow each at a pressure of 8.8 kg/cm^2g.

A fire water supply connection to the Residual Heat Removal System piping is provided from the portion of the FPS used for the Reactor and Control Buildings to provide an AC independent water addition system mode of the RHR System for reactor vessel injection or drywell sprays.

Automatic foam water extinguishing systems are provided for the diesel generator rooms and day tank rooms.

Fire detection and alarm systems are supplied with power from a non-Class 1E uninterruptible power supply.

The FPS has the following displays and alarms in the Main Control Room (MCR):

(1) Detection system fire alarms.

(2) Status of FPS pumps.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.6 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the Fire Protection System.

A plant fire hazards analysis considers potential fire hazards and assesses the effects of postulated fires on the ability to shutdown the reactor and to maintain the reactor in a ~~cold~~ safe, cold shutdown condition. Each postulated fire is documented in a Fire Hazards Report.

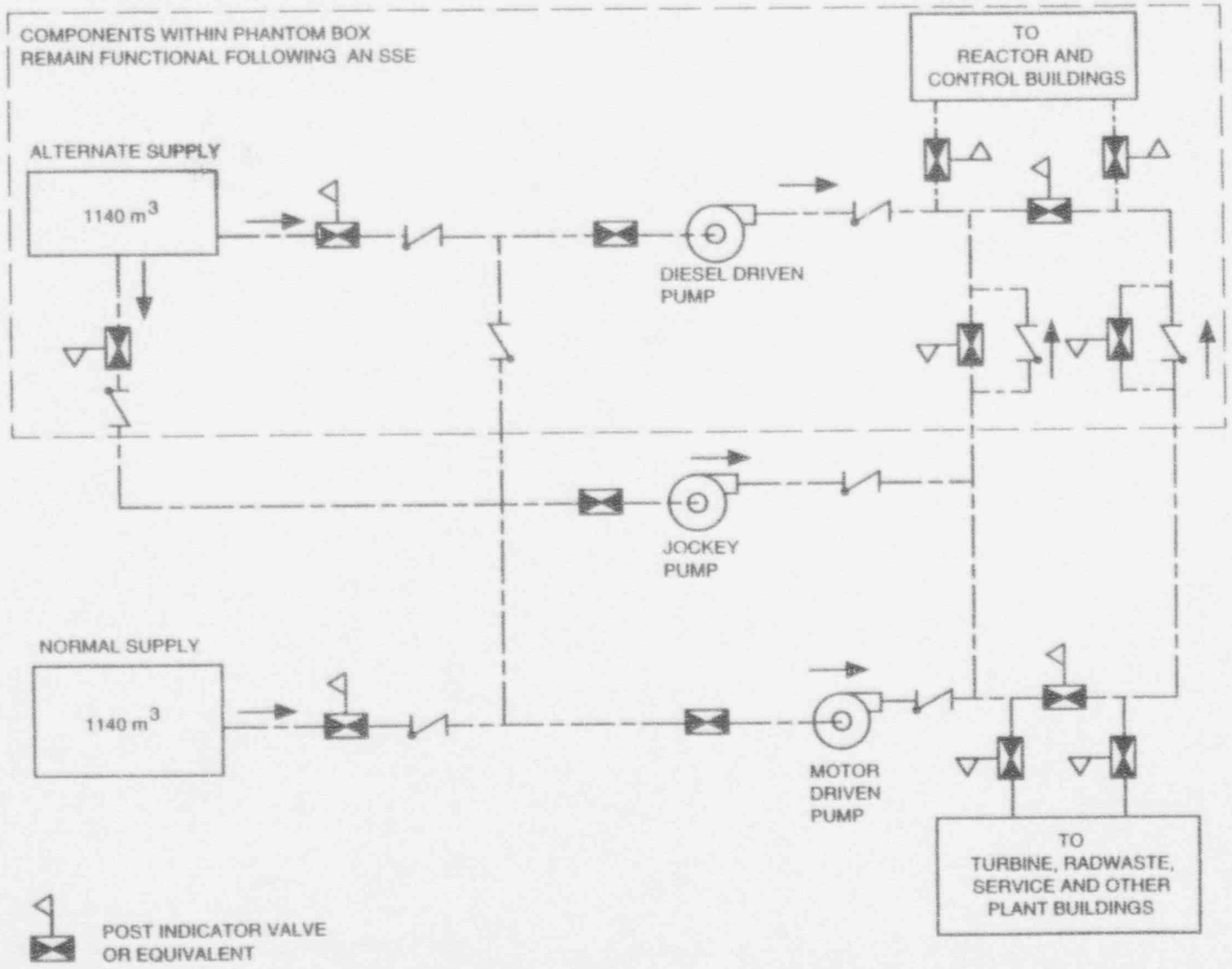

Figure 2.15.6 Fire Protection Water Supply System

Table 2.15.6 Fire Protection System

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1. The basic configuration for the FPS is defined in Section 2.15.6	1. Inspections of the as-built FPS will be conducted.	1. The as-built configuration of the FPS is in accordance with Section 2.15.6.
2. Fire detection and alarm systems are provided in all fire areas.	2. Inspection and testing of the as-built detectors will be performed using simulated fire conditions.	2. The detectors respond to the simulated fire conditions.
3. The FPS for the Reactor and Control Buildings supplies a minimum flow of 1890 liters/min at a pressure greater than 4.57 kg/cm^{2}g at the most hydraulically remote hose connection.	3. Tests will be conducted of the as-built FPS.	3. The FPS for the Reactor and Control Buildings supplies a minimum flow of 1890 liters/min at a pressure greater than 4.57 kg/cm^{2}g at the most hydraulically remote hose connection.
4. Automatic foam-water extinguishing systems are provided for the diesel generator and day tank rooms.	4. Inspections of the as-built foam-water extinguishing systems will be conducted. The automatic logic will be tested using simulated fire conditions.	4. The automatic foam-water suppression systems are present and initiation logic is actuated under simulated fire conditions.
5. The sprinkler systems and the standpipe systems in the Reactor and Control Buildings and the portions of the FPS water supply system identified in Figure 2.15.6 remain functional following an SSE.	5. Seismic analyses of the as-built FPS will be performed.	5. An analysis report exists which concludes that as-built sprinkler systems and the standpipe systems in the Reactor and Control Buildings and the portions of the FPS water supply system identified in Figure 2.15.6 remain functional following an SSE.
6. The fire detection and alarm systems are supplied with power from a non-Class 1E uninterruptible power supply.	6. Inspections of the as-built FPS will be conducted.	6. The FPS is supplied with power from a non-Class 1E uninterruptible power supply.
7. MCR alarms and displays provided for the FPS are as defined in Section 2.15.6.	7. Inspections will be performed on the MCR alarms, and displays for the FPS.	7. Alarms and displays exist or can be retrieved in the MCR as defined in Section 2.15.6.
8. Two fire water supply system pumps provide 5670 liters/min flow each at a pressure of 8.8 kg/cm^{2}g.	8. Tests will be conducted of the as-built FPS pumps in a test facility.	8. Two fire water supply system pumps provide 5670 liters/min flow each at a pressure of 8.8 kg/cm^{2}g.

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Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. A plant fire hazards analysis considers potential fire hazards and assesses the effects of postulated fires on the ability to shutdown the reactor and to maintain the reactor in a safe, cold shutdown condition. Each postulated fire is documented in a Fire Hazards Report.	9. Inspections of the Fire Hazards Report will be conducted.	9. A Fire Hazards Report exists for the as-built plant and concludes that for each postulated fire, the plant can be shutdown and maintained in a safe, cold shutdown condition.

SSAR CHANGES FIRE HAZARDS REPORT

level; therefore, the approach for the analysis was to review the system piping and instrument diagrams (P&IDs), and to prepare a database which listed every device that could be adversely affected by fire.

If the reviewers knew or became aware of something that would eventually be in the plant design but did not appear on any drawing at that time, it also was added to the list and assigned a special MPL number. This got the device into the database for tracking. If possible, each device was given an electrical safety division assignment and the assigned division was entered into the database.

If a device appeared on the building arrangement drawings, its actual location by row, column and elevation was entered into the database. For all other identified devices, an estimate of location by row, column and elevation, based on experience and the known location of nearby devices, was entered into the database. The validity of the location information for each item was indicated as being determined by reference to a drawing or by estimation.

The Fire Hazards Analysis was then performed on the verified or assumed plant design as documented by the database. This made it possible for a Fire Hazards Analysis to be performed on a specific plant configuration. It makes a record of the configuration analyzed available for use as a guide in completing the plant design. Also, at some time near the end of the design phase, the assumed information in the database may be compared to the actual design to confirm that the original Fire Hazard Analysis conclusions are still valid for final plant design. Any discrepancies may be analyzed and resolved at that time.

The ~~A~~ COL licensee will ~~applicant must~~ conduct a compliance review of the as-built design against the assumptions and requirements stated in the Fire Hazard Analysis as documented in Appendix 9B. Any non-compliance must be documented as being required and acceptable. ~~See Subsection 9.5.13.19 for COL license information.~~

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The basis of the overall plant design with respect to the effects of fire is to assume that all functions are lost for equipment, including electrical cables, located within a fire area experiencing a fire. Redundant equipment is provided in other fire areas. A fire area by fire area treatment for the Fire Hazard Analysis evaluates the compliance of the design to this requirement for redundancy. Compliance was confirmed or the need for corrective action was identified and initiated to achieve compliance to the overall plant design basis. Therefore, the most serious consequence of a fire is that it may incapacitate one safety or safe shutdown division. This is consistent with the single failure design criteria used throughout the plant. Regardless of the location of a fire, sufficient operable equipment is assured for use in safely shutting the plant down.

The Fire Hazard Analysis assumes that the function of a piece of equipment may be lost if the equipment is either involved in fire fighting activities or subjected to fire

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includes comparison with Table 9A.6-1 (database) and Table 9A.5-2 (special cases). In addition, the ~~COL applicant~~ licensee ~~shall~~ will demonstrate that multiple high impedence faults of those circuits described in Table 9A.5-2 resulting from a fire within any one fire area will not negatively impact other equipment fed from the same power source. Any non-compliance shall be documented as being required and acceptable on the basis of the Fire Hazard Analysis (Appendix 9A) and the Fire Protection Probabilistic Risk Assessment (Appendix 19M) (Subsection 9.5.1.4).

in a Fire Hazards Report

as-built reconciliation will

9.5.13.12 ~~NOT USED~~ DELETED

(3) Minimum isolation zone and protected area illumination capabilities cannot be defeated by sabotage actions outside of the protected area.

(4) Electromagnetic interference from plant equipment startups or power transfers will not create nuisance alarms or trip security access control systems.

~~9.5.13.12 Fire Hazard Analysis Compliance Review~~

~~The COL applicant will perform a compliance review of the as-built design against the assumptions and requirements stated in the Fire Hazard Analysis (Appendix 9A). This includes comparison with Table 9A.6-1 (database) and Table 9A.5-2 (special cases). In addition, the COL applicant shall demonstrate that multiple high impedence faults of those circuits described in Table 9A.5-2 resulting from a fire within any one fire area will not negatively impact other equipment fed from the same power source. Any non-compliance shall be documented as being required and acceptable on the basis of the Fire Hazard Analysis (Appendix 9A) and the Fire Protection Probabilistic Risk Assessment (Appendix 19M) (Subsection 9.5.1.4).~~

9.5.13.13 Diesel Fuel Refueling Procedures

The COL applicant shall establish procedures to verify that the day tank is full prior to refilling the storage tank. This minimizes the likelihood of sediment obstruction of fuel lines and any deleterious impacts on diesel generator operation.

9.5.13.14 Portable and Fixed Emergency Communication Systems

The COL applicant's design of the portable radio communication system and the fixed emergency communication system shall comply with BTP CMEB 9.5-1, position C.5.g(3) and (4). The COL applicant will supplement Subsection 9.5.2.6 accordingly, as applicable.

9.5.13.15 Identification of Chemicals

The COL applicant will provide protection features for liquid insulated transformers and will identify the type and location of chemicals as required by SRP Section 13.2.2 (Subsection 9.5.1.2).

9.5.13.16 NUREG/CR-0660 Diesel Generator Reliability Recommendations

Programs shall be developed to address NUREG/CR-0660 recommendations regarding training, preventive maintenance, and root-cause analysis of component and system failures.

9.5.13.17 Sound-Powered Telephone Units

The COL applicant shall provide the sound-powered telephone units to be used in conjunction with the system described in Subsection 9.5.2.2.2.

(PROPOSED CHANGES TO REFLECT ACRS FLOODING CONCERN)

2.15.10 Reactor Building

Design Description

The Reactor Building (R/B) is a structure which houses and provides protection and support for the reactor primary systems, the primary containment and much of the plant safety-related equipment. Figures 2.15.10a through 2.15.10o show the basic configuration and scope of the R/B*.

The R/B is constructed of reinforced concrete and structural steel with a steel frame and reinforced concrete roof. The R/B encloses the primary containment. The R/B slabs and fuel pool girders are integrated with the reinforced concrete containment vessel (RCCV). The R/B slabs are supported by columns, shear walls and beams to carry vertical loads to the basemat and transfer horizontal loads through the RCCV and R/B shear walls to the basemat and R/B foundation. The R/B, together with the RCCV and the reactor pedestal, are supported by a common basemat. Inside the RCCV, the basemat is considered part of the Primary Containment System (PCS); outside the RCCV, the basemat is part of the R/B. The top of the R/B basemat is located 20.2m ± 0.3m below the finished grade elevation.

The R/B is divided into three separate divisional areas for mechanical and electrical equipment and four divisional areas for instrumentation racks. Inter-divisional boundaries have the following features:

(1) Inter-divisional walls, floors, doors and penetrations which have three-hour fire rating.

(2) Watertight doors in the basement to prevent flooding in one division from propagating to other divisions.

(3) Divisional walls in the basement are 0.6 meters thick or greater.

Watertight doors on Emergency Core Cooling System rooms have open/close sensors with status indication and alarms in the main control room.

The R/B flooding that results from component failures in any of the R/B divisions does not prevent safe shutdown of the reactor. The basement floor is the collection location point for floods. The building configuration at this elevation is such that even for a flooding event involving release of either the suppression pool or the condensate storage tank (CST) water into the R/B, no more than one division of safety-related equipment is affected. Except for the basement area, safety-related electrical, instrumentation and control equipment is located at least 20 cm above the floor surface.

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* The overall building dimensions provided in Figures 2.15.10a through 2.15.10o are provided for information only and are not intended to be part of the certified ABWR information.

The R/B is protected against external flood. The following design features are provided:

(1) External walls below flood level are equal to or greater than 0.6 meters thick to prevent ground water seepage.

(2) Penetrations in the external walls below flood level are provided with flood protection features.

(3) A tunnel connects the Radwaste Building, Turbine Building and Reactor Building for the liquid radwaste system piping. The penetrations from the tunnel to the Reactor Building will be watertight.

The R/B is protected against the pressurization effects associated with postulated rupture of pipes containing high-energy fluid that occur in subcompartments of the R/B.

The R/B is classified as Seismic Category I. It is designed and constructed to accommodate the dynamic and static loading conditions associated with the various loads and load combinations which form the structural design basis. The loads are those associated with:

(1) Natural phenomena—wind, floods, tornados (including tornado missiles), earthquakes, rain and snow.

(2) Internal events—floods, pipe breaks and missiles.

(3) Normal plant operation—live loads, dead loads, temperature effects and building vibration loads.

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Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.10 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the R/B.

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Systems, structures and components located in the R/B and classified as safety-related are protected against inter-divisional flooding that results from postulated failures in Seismic Category I or non-nuclear safety (NNS) components located in the R/B or from external flooding events. Each postulated flooding event is documented in a Flood Analysis Report which ~~demonstrates~~ concludes the reactor can be shutdown safely and maintained in a safe, cold shutdown condition without offsite power.

Table 2.15.10 Reactor Building (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
8. The R/B is protected against external floods by having: a. External walls below flood level that are equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level provided with flood protection features. c. Watertight penetrations to the Reactor Building from the tunnel that connects the Radwaste Building, Turbine Building and Reactor Building for the liquid radwaste system piping.	8. Inspections of the as-built structure will be conducted.	8. a. External walls below flood level are equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level are provided with flood protection features. c. Penetrations from the tunnel to the Reactor Building are watertight.
9. The R/B is able to withstand the structural design basis loads as defined in Section 2.15.10.	9. A structural analysis will be performed which reconciles the as-built data with structural design basis as defined in Section 2.15.10.	9. A structural analysis report exists which concludes that the as-built R/B is able to withstand the structural design basis loads as defined in Section 2.15.10.

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Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
⑩ Systems, structures and components located in the R/B and classified as safety-related are protected against inter-divisional flooding that results from postulated failures in Seismic Category I or NNS related components located in the R/B or from external flooding events. Each postulated flooding event is documented in a Flood Analysis Report which ~~demonstrates~~ concludes the reactor can be shutdown safely and maintained in a safe, cold shutdown condition without offsite power.	⑩ Inspections of the Flood Analysis Report and the as-built flood protection features will be conducted	⑩ A Flood Analysis Report exists for the as-built R/B and concludes that for each postulated flooding event, the reactor can be shutdown safely and maintained in a safe, cold shutdown condition without offsite power. The Flood Analysis Report includes the results of inspections of the as-built flood protection features.

PROPOSED CHANGES TO REFLECT ACRS FLOODING CONCERNS.

2.15.12 Control Building

Design Description

The Control Building (C/B) is a structure which houses and provides protection and support for plant control and electrical equipment, batteries, portions of the Reactor Building Cooling Water (RCW) System, and C/B heating, ventilating and air conditioning equipment. The C/B is located between the Reactor and Turbine Buildings. Figures 2.15.12a through 2.15.12h show the basic configuration and scope of the C/B.*

The C/B is constructed of reinforced concrete and structural steel. The C/B is a shear-wall structure (which accommodates seismic loads) consisting of the perimeter walls, the steam-tunnel walls and the connected supporting floors. Columns and walls carry vertical loads to the basemat. The top of the C/B basemat is located 20.2m ±0.3m below the finished grade elevation.

The C/B, except for the main control area envelope, is divided into three separate divisional areas for mechanical and electrical equipment and four divisional areas for instrumentation and control equipment (including batteries). Interdivisional boundaries have the following features:

(1) Interdivisional walls, floors, doors and penetrations which have three-hour fire rating.

(2) Watertight doors to prevent flooding in one division from propagating to other divisions.

(3) Divisional walls in the basement are 0.6m thick or greater.

The main control area envelope is separated from the rest of the C/B by walls, floors, doors and penetrations which have three-hour fire rating.

Watertight doors between flood divisions have open/close sensors with status indication and alarms in the main control room.

The C/B flooding that results from component failures in any of the C/B divisions does not prevent safe shutdown of the reactor. The basement floor is the collection point for floods. Except for the basement and main control area envelope, safety-related electrical equipment and instrumentation and control equipment is located at least 20 centimeters above the floor surface. Level sensors are located in the basement area of each of the three mechanical divisions. These sensors send signals to the corresponding

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* The overall building dimensions provided in Figures 2.15.12a through 2.15.12h are for information only and are not intended to be part of the certified ABWR information.

divisions of the Reactor Service Water (RSW) System indicating flooding in that division of the C/B. These sensors are located no higher than 1500 mm above the C/B basement floor.

The basement area level sensors are powered from their respective divisional Class 1E power supply. Independence is provided between the Class 1E divisions for these sensors and also between the Class 1E divisions and non-Class 1E equipment.

To protect the C/B against an external flood the following design features are provided:

(1) External walls below flood level are equal to or greater than 0.6m thick to prevent ground water seepage.

(2) Penetrations in the external walls below flood level are provided with flood protection features.

Within the C/B, the steam tunnel has no penetrations from the steam tunnel into other areas of the C/B. The concrete thickness of the steam tunnel walls, floor and ceiling within the C/B is equal to or greater than 1.6m.

The C/B is classified as Seismic Category I. It is designed and constructed to accommodate the dynamic and static loading conditions associated with the various loads and load combinations which form the structural design basis. The loads are those associated with:

(1) Natural phenomena—wind, floods, tornadoes (including tornado missiles), earthquakes, rain and snow.

(2) Internal events—floods, pipe breaks and missiles.

(3) Normal plant operation—live loads, dead loads and temperature effects.

The steam tunnel is protected against pressurization effects that occur in the steam tunnel as a result of postulated rupture of pipes containing high energy fluid.

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Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.12 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the Control Building.

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Systems, structures and components located in the C/B and classified as safety-related are protected against inter-divisional flooding that results from postulated failures in Seismic Category I or non-nuclear safety (NNS) components located in the C/B or from external flooding events. Each postulated flooding event is documented in a Flood Analysis Report which ~~demonstrates~~ concludes the reactor can be shutdown safely and maintained in a safe, cold shutdown condition without offsite power.

Table 2.15.12 Control Building

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1. The basic configuration of the C/B is shown on Figures 2.15.12a through 2.15.12h.	1. Inspections of the as-built structure will be conducted.	1. The as-built C/B conforms with the basic configuration shown on Figures 2.15.12a through 2.15.12h.
2. The top of the C/B basemat is located 20.2m ±0.3m below the finished grade elevation.	2. Inspections of the as-built structure will be conducted.	2. The top of the C/B basemat is located 20.2m ±0.3m below the finished grade elevation.
3. Inter-divisional walls, floors, doors and penetrations in the C/B have a three-hour fire rating.	3. Inspections of the as-installed inter-divisional boundaries will be conducted.	3. The as-installed walls, floors, doors and penetrations that form the inter-divisional boundaries have a three-hour fire rating.
4. The C/B has divisional areas with walls and watertight doors as shown on Figures 2.15.12a through 2.15.12h.	4. Inspections of the as-built walls, and doors will be conducted.	4. The as-built C/B has walls and watertight doors as shown on Figures 2.15.12a through 2.15.12h.
5. The main control area envelope is separated from the rest of the C/B by walls, floors, doors and penetrations which have a three-hour fire rating.	5. Inspections of the as-built structure will be conducted.	5. The as-built C/B has a main control area envelope separated from the rest of the C/B by walls, floors, doors and penetrations which have a three-hour fire rating.
6. Main control room displays and alarms provided for the C/B are as defined in Section 2.15.12.	6. Inspections will be performed on the main control room displays and alarms for the C/B.	6. Displays and alarms exist or can be retrieved in the main control room as defined in Section 2.15.12.
7. Except for the basemat and main control area envelope, safety-related electrical equipment and instrumentation, and control equipment is located at least 20 cm above the floor surface.	7. Inspections will be conducted of the as-built equipment.	7. Except for the basemat and main control area envelope, safety-related electrical equipment and instrumentation, and control equipment is located at least 20 cm above the floor surface.
8. Level sensors are located in the basement area of each of the three mechanical divisions. These sensors are located no higher than 1500 mm above the C/B basement floor.	8. Inspections of the as-built equipment will be conducted.	8. Level sensors are located in the basement area of each of the three mechanical divisions. These sensors are located no higher than 1500 mm above the C/B basement floor.

Table 2.15.12 Control Building (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
9. The basement area level sensors are powered from their respective divisional Class 1E power supply. Independence is provided between the Class 1E divisions for these sensors and also between the Class 1E divisions and non-Class 1E equipment.	9. a. Tests will be conducted on the as-built sensors by providing a test signal in only one Class 1E division at a time. b. Inspections of the as-installed Class 1E divisions will be conducted.	9. a. The test signal exists only in the Class 1E division under test. b. Physical separation or electrical isolation exists between Class 1E divisions. Physical separation or electrical isolation exists between these Class 1E divisions and non-Class 1E equipment.
10. The C/B is protected against external floods by having: a. External walls below flood level equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level provided with flood protection features.	10. Inspections of the as-built structure will be conducted.	10. The C/B is protected against external floods by having: a. External walls below flood level equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level provided with flood protection features.
11. Within the C/B, the steam tunnel has no penetrations from the steam tunnel into other areas of the C/B.	11. Inspections of the as-built structure will be conducted.	11. Within the C/B, the steam tunnel has no penetrations from the steam tunnel into other areas of the C/B.
12. The concrete thickness of the steam tunnel walls, floor and ceiling within the C/B is equal to or greater than 1.6m.	12. Inspections of the as-built structure will be conducted.	12. The concrete thickness of the steam tunnel walls, floor and ceiling within the C/B is equal to or greater than 1.6m.
13. The C/B is able to withstand the structural design basis loads as defined in Section 2.15.12.	13. A structural analysis will be performed which reconciles the as-built data with structural design basis as defined in Section 2.15.12.	13. A structural analysis report exists which concludes that the as-built C/B is able to withstand the structural design basis loads as defined in Section 2.15.12.

ADD NEW # 14 PER ATTACHED

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
⑭ Systems, structures and components located in the C/B and classified as safety-related are protected against inter-divisional flooding that results from postulated failures in Seismic Category I or NNS related components located in the C/B or from external flooding events. Each postulated flooding event is documented in a Flood Analysis Report which ~~demonstrates~~ concludes the reactor can be shutdown safely and maintained in a safe, cold shutdown condition without offsite power.	⑭ Inspections of the Flood Analysis Report and the as-built flood protection features will be conducted	⑭ A Flood Analysis Report exists for the as-built C/B and concludes that for each postulated flooding event, the reactor can be shutdown safely and maintained in a safe, cold shutdown condition without offsite power. The Flood Analysis Report includes the results of inspections of the as-built flood protection features.

3.4 Water Level (Flood) Design

Criteria for the design basis for protection against external flooding of an ABWR plant site shall conform to the requirements of RG 1.59. The types and methods used for protecting the ABWR safety-related structures, systems and components from external flooding shall conform to the guidelines defined in Regulatory Guide RG 1.102. The design criteria for protection against the effects of compartment flooding shall conform to the requirements of ANSI/ANS-56.11 (Reference 3.4-2).

The design basis flood levels and ground water levels for the ABWR standard plant are shown in Table 3.4-1 as specified by Table 2.0-1. For those structures outside the scope of the ABWR Standard Plant (e.g., the ultimate heat sink pump house), the COL applicant will demonstrate the structures outside the scope meet the requirements of Table 2.0-1 and GDC 2 and the guidance of RG 1.102. See Subsections 3.4.3.1, 3.4.3.2, and 3.4.3.3 for COL license information requirements.

3.4.1 Flood Protection

This section discusses the flood protection measures that are applicable to the standard ABWR plant safety-related structures, systems, and components for both external flooding and postulated flooding from plant component failures. These protection measures also apply to other structures that house systems and components important to safety which fall within the scope of specific plant. ← INSERT Ⓐ

3.4.1.1 Flood Protection Measures for Structures

The safety-related systems and components of the ABWR Standard Plant are located in the Reactor and Control Buildings which are Seismic Category I structures. Descriptions of these structures are provided in Subsections 3.8.4 and 3.8.5. The ABWR standard plant structures are protected as required (Table 3.4-1), against the postulated design basis flood level specified in Table 2.0-1. Postulated flooding from component failures in the building compartments is prevented from adversely affecting plant safety or posing any hazard to the public.

Table 3.4-1 identifies the exterior or access openings and penetrations that are provided with features for protection against floods.

3.4.1.1.1 Flood Protection from External Sources

The safety-related components located below the design basis flood level inside a Seismic Category I structure are shown in the Section 1.2 building arrangement drawings. All safety-related components located below the design flood level are protected using the hardened protection approach described below.

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¶ The COL licensee will conduct a compliance review of the as-built design against the assumptions and requirements that are the basis of the flood evaluation presented below. This as-built evaluation will be documented in a Flood Analysis Report. The report will include an assessment and disposition of any non-compliances that are found between the as-built facility and the information in this Section. The criterion for determining appropriate any non-compliance(s) disposition of ~~is~~ will be that the final as-built facility conforms with the following flood protection characteristics.

Seismic Category I structures remain protected for safe shutdown of the reactor during all flood conditions.

The safety-related systems and components are flood-protected either because they are located above the design flood level or are enclosed in reinforced concrete Seismic Category I structures which have the following features:

(1) Exterior walls below flood level are not less than 0.6m thick.

(2) Water stops are provided in all construction joints below flood level.

(3) Watertight doors, equipment hatches and penetrations are installed below flood level.

(4) Waterproof coating is applied to external surfaces exposed to flood level, and is extended a minimum of 150 mm along the penetration surfaces.

(5) Roofs are designed to prevent pooling of large amounts of water in accordance with RG 1.102.

Waterproofing of foundations and walls of Seismic Category I structures below grade is accomplished principally by the use of water stops at expansion and construction joints. In addition to water stops, waterproofing of the plant structures and penetrations that house safety-related systems and components is provided up to 8 cm above the plant ground level to protect the external surfaces from exposure to water.

The flood protection measures that are described above also guard against flooding from onsite storage tanks that may rupture. The largest is the condensate storage tank.

This tank is located between the Turbine Building and the radwaste building where there are no direct entries to these buildings. All plant entries start 30 cm above grade. Any flash flooding that may result from tank rupture will drain away from the site and cause no damage to site equipment.

Additional specific provisions for flood protection include administrative procedures to assure that all watertight doors and hatch covers are locked in the event of a flood warning. If local seepage occurs through the walls, it is controlled by sumps and sump pumps. Deterioration of exterior building wall penetration seals will be detectable by visual seepage. Corrective actions can be taken in a timely manner to control the problem. The COL ~~applicant~~ licensee will review the use of penetration seals below grade and develop procedures as necessary to protect the plant against the effects of seal failure. This ~~See Subsection 3.4.3.4 for COL license information.~~ review will be included in the Flood Analysis Report (Section 3.4.1) and will contain information that INSERT (B)

INSERT Ⓑ

shows that the ability to safely shutdown the reactor and maintain a safe, cold shutdown condition is maintained because either a) the penetration seals are highly reliable or b) emergency procedures are in place to guide the plant response to a postulated seal failure followed by flooding.

3.4.3.3 Flood Protection Requirements for Other Structures

The COL applicant will demonstrate, for the structures outside the scope of the ABWR Standard Plant, that they meet the requirements of GDC 2 and the guidance of RG 1.102 (Subsection 3.4).

← ~~NOT USED~~ DELETED

~~3.4.3.4 Penetration Seals~~

~~The COL applicant shall demonstrate that penetration seal failure of an exterior building wall below grade will not result in a loss of the ability to safely shutdown the plant by either the use of highly reliable seals or the development of emergency procedures to respond to the failure of a penetration seal. (Subsection 3.4.1.1.1)~~

3.4.4 References

3.4-1 Crane Co., *Flow of Fluids Through Valves, Fittings, and Pipe*, Technical Paper No. 410, 1973.

3.4-2 ANSI/ANS 56.11, Standard, *Design Criteria for Protection Against the Effects of Compartment Flooding in Light Water Reactor Plants.*

3.4-3 Regulatory Guide 1.59, *Design Basis Floods for Nuclear Power Plants.*

REVISION FOR TUNNELS

2.15.10 Reactor Building

Design Description

The Reactor Building (R/B) is a structure which houses and provides protection and support for the reactor primary systems, the primary containment and much of the plant safety-related equipment. Figures 2.15.10a through 2.15.10o show the basic configuration and scope of the R/B[*].

The R/B is constructed of reinforced concrete and structural steel with a steel frame and reinforced concrete roof. The R/B encloses the primary containment. The R/B slabs and fuel pool girders are integrated with the reinforced concrete containment vessel (RCCV). The R/B slabs are supported by columns, shear walls and beams to carry vertical loads to the basemat and transfer horizontal loads through the RCCV and R/B shear walls to the basemat and R/B foundation. The R/B, together with the RCCV and the reactor pedestal, are supported by a common basemat. Inside the RCCV, the basemat is considered part of the Primary Containment System (PCS); outside the RCCV, the basemat is part of the R/B. The top of the R/B basemat is located 20.2m ± 0.3m below the finished grade elevation.

The R/B is divided into three separate divisional areas for mechanical and electrical equipment and four divisional areas for instrumentation racks. Inter-divisional boundaries have the following features:

(1) Inter-divisional walls, floors, doors and penetrations which have three-hour fire rating.

, and penetrations in the external R/B walls to connecting tunnels,

(2) Watertight doors in the basement to prevent flooding in one division from propagating to other divisions.

(3) Divisional walls in the basement are 0.6 meters thick or greater.

Watertight doors on Emergency Core Cooling System rooms have open/close sensors with status indication and alarms in the main control room.

The R/B flooding that results from component failures in any of the R/B divisions does not prevent safe shutdown of the reactor. The basement floor is the collection location point for floods. The building configuration at this elevation is such that even for a flooding event involving release of either the suppression pool or the condensate storage tank (CST) water into the R/B, no more than one division of safety-related equipment is affected. Except for the basement area, safety-related electrical, instrumentation and control equipment is located at least 20 cm above the floor surface.

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[*] The overall building dimensions provided in Figures 2.15.10a through 2.15.10o are provided for information only and are not intended to be part of the certified ABWR information.

The R/B is protected against external flood. The following design features are provided:

(1) External walls below flood level are equal to or greater than 0.6 meters thick to prevent ground water seepage.

(2) Penetrations in the external walls below flood level are provided with flood protection features.

(3) A tunnel connects the Radwaste Building, Turbine Building and Reactor Building for the liquid radwaste system piping. The penetrations from the tunnel to the Reactor Building will be watertight.

The R/B is protected against the pressurization effects associated with postulated rupture of pipes containing high-energy fluid that occur in subcompartments of the R/B.

INSERT 2

The R/B and oil transfer tunnels are ~~is~~ classified as Seismic Category I. They are ~~It is~~ designed and constructed to accommodate the dynamic and static loading conditions associated with the various loads and load combinations which form the structural design basis. The loads are (as applicable) those associated with:

(1) Natural phenomena—wind, floods, tornados (including tornado missiles), earthquakes, rain and snow.

(2) Internal events—floods, pipe breaks and missiles.

(3) Normal plant operation—live loads, dead loads, temperature effects and building vibration loads.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.10 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the R/B.

INSERT Z

There are three divisionaly separated tunnels for routing Oil Storage and Transfer (OST) System piping from the fuel oil storage tanks to the R/B. These tunnels are configured so that any fuel oil leakage does not accumulate at the R/B boundary. Tunnel flooding due to site flood conditions is precluded by protecting the entrances against water entry.

Table 2.15.10 Reactor Building

And external wall penetrations to connecting tunnels

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1. The basic configuration of the R/B is shown on Figures 2.15.10a through 2.15.10o.	1. Inspections of the as-built structure will be conducted.	1. The as-built R/B conforms with the basic configuration shown in Figures 2.15.10a through 2.15.10o.
2. The top of the R/B basemat is located 20.2m ±0.3m below the finished grade elevation.	2. Inspections of the as-built structure will be conducted.	2. The top of the R/B basemat is located 20.2m ±0.3m below the finished grade elevation.
3. Inter-divisional walls, floors, doors and penetrations ~~in the R/B~~ have a three-hour fire rating.	3. Inspections of the as-installed inter-divisional boundaries will be conducted.	3. The as-installed walls, floors, doors and penetrations that form the inter-divisional boundaries have a three-hour fire rating.
4. The R/B has divisional areas with walls and watertight doors are as shown on Figures 2.15.10a through 2.15.10o.	4. Inspections of the as-built walls and watertight doors will be conducted.	4. The as-built R/B has walls and watertight doors as shown on Figures 2.15.10a through 2.15.10o.
5. Main control room displays and alarms provided for the R/B are as defined in Section 2.15.10.	5. Inspections will be performed on the main control room displays and alarms for the R/B.	5. Displays and alarms exist or can be retrieved in the main control room as defined in Section 2.15.10.
6. A flooding event involving release of either the suppression pool or the CST water does not affect more than one division of safety-related equipment.	6. Inspections will be conducted of the divisional boundaries shown on Figure 2.15.10c.	6. Penetrations (except for watertight doors) in the divisional walls are at least 2.5m above the floor level of -8200 mm.
7. Except for the basement area, safety-related electrical, instrumentation, and control equipment is located at least 20 cm above the floor surface.	7. Inspections will be conducted of the as-built equipment.	7. Except for the basement area, safety-related electrical, instrumentation, and control equipment is located at least 20 cm above the floor surface.

and external wall penetrations to connecting tunnels

, and penetrations in the external R/B walls to connecting tunnels,

Table 2.15.10 Reactor Building (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
8. The R/B is protected against external floods by having: a. External walls below flood level that are equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level provided with flood protection features. c. Watertight penetrations to the Reactor Building from the tunnel that connects the Radwaste Building, Turbine Building and Reactor Building for the liquid radwaste system piping.	8. Inspections of the as-built structure will be conducted.	8. a. External walls below flood level are equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level are provided with flood protection features. c. Penetrations from the tunnel to the Reactor Building are watertight.
~~9.~~ 10 The R/B ~~is~~ and oil transfer tunnels are able to withstand the structural design basis loads as defined in Section 2.15.10.	~~9.~~ 10 A structural analysis will be performed which reconciles the as-built data with structural design basis as defined in Section 2.15.10.	~~9.~~ 10 A structural analysis report exists which concludes that the as-built R/B ~~is~~ and oil transfer tunnels are able to withstand the structural design basis loads as defined in Section 2.15.10.

Add new #9 per attached.

Table 2.15.10 – New entry #9

9. There are three divisionally separated tunnels for routing OST System piping from the fuel storage tanks to the R/B. These tunnels are configured so that any fuel oil leakage does not accumulate at the R/B boundary. Tunnel flooding due to site flood conditions is precluded by protecting the entrances against water entry	9. Inspections of the as-built tunnels will be conducted	9. Repeat the wording from the right hand column.

CHANGES FOR TUNNELS

2.15.11 Turbine Building

Design Description

The Turbine Building (T/B) includes the electrical building and houses the main turbine generator and other power conversion cycle equipment and auxiliaries. The T/B is located adjacent to the safety-related Seismic Category I Control Building. With the exception of instrumentation associated with monitoring of condenser pressure, turbine first-stage pressure, turbine control valve oil pressure and stop valve position, there is no safety-related equipment in the T/B. The electrical building houses various plant support systems and equipment such as non-divisional switchgear and chillers.

A tunnel connects the Radwaste Building, Turbine Building and Reactor Building for the liquid radwaste system piping. The penetrations from the tunnel to the Turbine Building ~~will be~~ are watertight and have a three hour fire rating.

Flood conditions in the T/B are prevented from propagating into the Control Building (C/B) via the Service Building. This is achieved by locating the access from the T/B to the S/B at or above grade level and providing a flood control doorway at the access location.

The T/B is not classified as a Seismic Category I structure. However, the building is designed such that damage to safety-related functions does not occur under seismic loads corresponding to the safe shutdown earthquake (SSE) ground acceleration.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.11 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the Turbine Building.

Table 2.15.11 Turbine Building

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1. The basic configuration of the T/B is described in Section 2.15.11.	1. Inspections of the as-built structure will be conducted.	1. The as-built T/B conforms with the basic configuration described in Section 2.15.11.
2. The T/B is designed such that damage to safety-related functions does not occur under seismic loads corresponding to the SSE ground acceleration.	2. A seismic analysis of the as-built T/B will be performed.	2. A structural analysis report exists which concludes that under seismic loads corresponding to the SSE ground acceleration the as-built T/B does not damage safety-related functions.

CHANGES FOR TUNNELS

2.15.12 Control Building

Design Description

The Control Building (C/B) is a structure which houses and provides protection and support for plant control and electrical equipment, batteries, portions of the Reactor Building Cooling Water (RCW) System, and C/B heating, ventilating and air conditioning equipment. The C/B is located between the Reactor and Turbine Buildings. Figures 2.15.12a through 2.15.12h show the basic configuration and scope of the C/B.*

The C/B is constructed of reinforced concrete and structural steel. The C/B is a shear-wall structure (which accommodates seismic loads) consisting of the perimeter walls, the steam-tunnel walls and the connected supporting floors. Columns and walls carry vertical loads to the basemat. The top of the C/B basemat is located 20.2m ±0.3m below the finished grade elevation.

The C/B, except for the main control area envelope, is divided into three separate divisional areas for mechanical and electrical equipment and four divisional areas for instrumentation and control equipment (including batteries). Interdivisional boundaries have the following features:

(1) Interdivisional walls, floors, doors and penetrations which have three-hour fire rating.

) and penetrations in the external C/B walls to connecting tunnels)

(2) Watertight doors to prevent flooding in one division from propagating to other divisions.

(3) Divisional walls in the basement are 0.6m thick or greater.

The main control area envelope is separated from the rest of the C/B by walls, floors, doors and penetrations which have three-hour fire rating.

Watertight doors between flood divisions have open/close sensors with status indication and alarms in the main control room.

The C/B flooding that results from component failures in any of the C/B divisions does not prevent safe shutdown of the reactor. The basement floor is the collection point for floods. Except for the basement and main control area envelope, safety-related electrical equipment and instrumentation and control equipment is located at least 20 centimeters above the floor surface. Level sensors are located in the basement area of each of the three mechanical divisions. These sensors send signals to the corresponding

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* The overall building dimensions provided in Figures 2.15.12a through 2.15.12h are for information only and are not intended to be part of the certified ABWR information.

divisions of the Reactor Service Water (RSW) System indicating flooding in that division of the C/B. These sensors are located no higher than 1500 mm above the C/B basement floor.

The basement area level sensors are powered from their respective divisional Class 1E power supply. Independence is provided between the Class 1E divisions for these sensors and also between the Class 1E divisions and non-Class 1E equipment.

To protect the C/B against an external flood the following design features are provided:

(1) External walls below flood level are equal to or greater than 0.6m thick to prevent ground water seepage.

(2) Penetrations in the external walls below flood level are provided with flood protection features.

Within the C/B, the steam tunnel has no penetrations from the steam tunnel into other areas of the C/B. The concrete thickness of the steam tunnel walls, floor and ceiling within the C/B is equal to or greater than 1.6m.

The C/B is classified as Seismic Category I. It is designed and constructed to accommodate the dynamic and static loading conditions associated with the various loads and load combinations which form the structural design basis. The loads are those associated with:

(1) Natural phenomena—wind, floods, tornadoes (including tornado missiles), earthquakes, rain and snow.

(2) Internal events—floods, pipe breaks and missiles.

(3) Normal plant operation—live loads, dead loads and temperature effects.

The steam tunnel is protected against pressurization effects that occur in the steam tunnel as a result of postulated rupture of pipes containing high energy fluid.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.12 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the Control Building.

, and penetrations in the external C/B walls to connecting tunnels

Table 2.15.12 Control Building

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1. The basic configuration of the C/B is shown on Figures 2.15.12a through 2.15.12h.	1. Inspections of the as-built structure will be conducted.	1. The as-built C/B conforms with the basic configuration shown on Figures 2.15.12a through 2.15.12h.
2. The top of the C/B basemat is located 20.2m ±0.3m below the finished grade elevation.	2. Inspections of the as-built structure will be conducted.	2. The top of the C/B basemat is located 20.2m ±0.3m below the finished grade elevation.
3. Inter-divisional walls, floors, doors and penetrations ~~in [illegible] C/B~~ have a three-hour fire rating.	3. Inspections of the as-installed inter-divisional boundaries will be conducted.	3. The as-installed walls, floors, doors and penetrations that form the inter-divisional boundaries have a three-hour fire rating.
4. The C/B has divisional areas with walls and watertight doors as shown on Figures 2.15.12a through 2.15.12h.	4. Inspections of the as-built walls, and doors will be conducted.	4. The as-built C/B has walls and watertight doors as shown on Figures 2.15.12a through 2.15.12h.
5. The main control area envelope is separated from the rest of the C/B by walls, floors, doors and penetrations which have a three-hour fire rating.	5. Inspections of the as-built structure will be conducted.	5. The as-built C/B has a main control area envelope separated from the rest of the C/B by walls, floors, doors and penetrations which have a three-hour fire rating.
6. Main control room displays and alarms provided for the C/B are as defined in Section 2.15.12.	6. Inspections will be performed on the main control room displays and alarms for the C/B.	6. Displays and alarms exist or can be retrieved in the main control room as defined in Section 2.15.12.
7. Except for the basemat and main control area envelope, safety-related electrical equipment and instrumentation, and control equipment is located at least 20 cm above the floor surface.	7. Inspections will be conducted of the as-built equipment.	7. Except for the basemat and main control area envelope, safety-related electrical equipment and instrumentation, and control equipment is located at least 20 cm above the floor surface.
8. Level sensors are located in the basement area of each of the three mechanical divisions. These sensors are located no higher than 1500 mm above the C/B basement floor.	8. Inspections of the as-built equipment will be conducted.	8. Level sensors are located in the basement area of each of the three mechanical divisions. These sensors are located no higher than 1500 mm above the C/B basement floor.

and external wall penetrations to connecting tunnels

Table 2.15.12 Control Building (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
9. The basement area level sensors are powered from their respective divisional Class 1E power supply. Independence is provided between the Class 1E divisions for these sensors and also between the Class 1E divisions and non-Class 1E equipment.	9. a. Tests will be conducted on the as-built sensors by providing a test signal in only one Class 1E division at a time. b. Inspections of the as-installed Class 1E divisions will be conducted.	9. a. The test signal exists only in the Class 1E division under test. b. Physical separation or electrical isolation exists between Class 1E divisions. Physical separation or electrical isolation exists between these Class 1E divisions and non-Class 1E equipment.
10. The C/B is protected against external floods by having: a. External walls below flood level equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level provided with flood protection features.	10. Inspections of the as-built structure will be conducted.	10. The C/B is protected against external floods by having: a. External walls below flood level equal to or greater than 0.6m thick to prevent ground water seepage. b. Penetrations in the external walls below flood level provided with flood protection features.
11. Within the C/B, the steam tunnel has no penetrations from the steam tunnel into other areas of the C/B.	11. Inspections of the as-built structure will be conducted.	11. Within the C/B, the steam tunnel has no penetrations from the steam tunnel into other areas of the C/B.
12. The concrete thickness of the steam tunnel walls, floor and ceiling within the C/B is equal to or greater than 1.6m.	12. Inspections of the as-built structure will be conducted.	12. The concrete thickness of the steam tunnel walls, floor and ceiling within the C/B is equal to or greater than 1.6m.
13. The C/B is able to withstand the structural design basis loads as defined in Section 2.15.12.	13. A structural analysis will be performed which reconciles the as-built data with structural design basis as defined in Section 2.15.12.	13. A structural analysis report exists which concludes that the as-built C/B is able to withstand the structural design basis loads as defined in Section 2.15.12.

CHANGES FOR TUNNELS

2.15.13 Radwaste Building

Design Description

The Radwaste Building (RW/B) is a structure which houses the solid and liquid radwaste treatment systems. The RW/B is classified as non-safety-related.

Flood conditions in the RW/B are prevented from propagating into the Reactor Building and Turbine Building by providing the penetrations in external walls below flood level with flood protection features.

A tunnel connects the Radwaste Building, Turbine Building and Reactor Building for the liquid radwaste system piping. The penetrations from the tunnel to the Radwaste Building ~~will be~~ are watertight, and have a three hour fire rating.

The external walls of the RW/B below grade and the basemat are classified as Seismic Category I. The exterior walls above grade, the floor slabs, the interior columns, and the roof are classified as non-seismic.

The external walls of the RW/B below grade and the basemat are designed and constructed to accommodate the dynamic and static loading conditions associated with the various loads and load combinations which form the structural design basis. The loads are those associated with:

(1) Natural phenomena—wind, floods, tornados, earthquakes, rain and snow.

(2) Internal event—floods.

(3) Normal plant operations—live loads, dead loads and temperature effects.

The exterior walls above grade, the floor slabs, the interior columns and the roof are designed such that damage to safety-related functions does not occur under seismic loads corresponding to the safe shutdown earthquake (SSE) ground acceleration.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.13 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the Radwaste Building.

Insert (Y)

Insert Ⓨ

The tunnel connecting the Radwaste Building, Turbine Building and Reactor Building is designed such that damage to penetration seals at the interface with safety-related structures does not occur under seismic loads corresponding to the safe shutdown earthquake (SSE) ground acceleration. Flooding of this tunnel during design basis site flood conditions is prevented.

Table 2.15.13 Radwaste Building

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1. The basic configuration of the RW/B is described in Section 2.15.13.	1. Inspections of the as-built structure will be conducted.	1. The as-built RW/B conforms with the basic configuration in Section 2.15.13.
2. The external walls of the RW/B below grade and the basemat are able to withstand the design basis loadings as defined in Section 2.15.13.	2. A structural analysis will be performed which reconciles the as-built data with the structural design basis as defined in Section 2.15.13.	2. A structural analysis report exists which concludes that the as-built RW/B is able to withstand the structural design basis loads as defined in Section 2.15.13.
3. The exterior walls above grade, the floor slabs, the interior columns and the roof are designed such that damage to safety-related functions does not occur under seismic loads corresponding to the SSE ground acceleration.	3. A seismic analysis will be performed.	3. A structural analysis report exists which concludes that under seismic loads corresponding to the SSE ground acceleration, the as-built RW/B does not damage safety-related functions.
4. The tunnel connecting the Radwaste Building, Turbine Building and Reactor Building is designed such that damage to penetration seals at the interface with safety-related structures does not occur under seismic loads corresponding to the safe shutdown earthquake (SSE) ground acceleration.	4. A seismic analysis will be performed!	4. A structural analysis report exists which concludes that under seismic loads corresponding to the SSE ground acceleration, the tunnel does not damage penetration seals at the interface with safety-related structures.

REVISION FOR TUNNELS

2.11.9 Reactor Service Water System

Design Description

The Reactor Service Water (RSW) System removes heat from the Reactor Building Cooling Water (RCW) System and rejects this heat to the Ultimate Heat Sink (UHS). The portions of the RSW System that are in the Control Building are within the Certified Design. Those portions of the RSW System that are outside the Control Building are not in the Certified Design. Figure 2.11.9a shows the basic system configuration and scope within the Certified Design. Figure 2.11.9b shows the RSW System control interfaces.

The RSW System provides cooling water flow to either two or three of the RCW System heat exchangers in each division. On a loss-of-coolant accident (LOCA) signal, any closed valves for standby heat exchangers are automatically opened and cooling flow is provided to all three heat exchangers in each division.

For each division of the RSW System, the heat exchanger inlet and outlet valves close upon receipt of a signal indicating Control Building flooding in that division.

The RSW System is classified as Seismic Category I and ASME Code Section III, Class 3 and consists of three separate safety-related divisions.

Each of the three RSW divisions is powered by its respective Class 1E division. In the RSW System, independence is provided between Class 1E divisions, and also between the Class 1E divisions and non-Class 1E equipment. Each mechanical division of the RCW system (Divisions A, B, C) is physically separated from the other divisions.

The RSW System has the following main control room (MCR) displays and controls: control and status displays for the valves shown on Figure 2.11.9a. The RSW System components with status displays and control interfaces with the Remote Shutdown System (RSS) are identified in Figure 2.11.9a.

The motor-operated valves (MOVs) shown on Figure 2.11.9a all have active safety-related functions to open and close under differential pressure and fluid flow conditions.

Interface Requirements

Part of the RSW System that are not within the Certified Design shall meet the following requirements:

(1) Design features shall be provided to limit the maximum flood height to 5.0 meters in each RCW heat exchanger room.

(2) The design shall have three divisions which are physically separated. Each division shall be powered by its respective Class 1E division. Each division shall be capable of removing the design heat capacity (as specified in Section 2.11.3) of the RCW heat exchangers in its division.

(3) Upon receipt of a loss-of-coolant (LOCA) signal, components in standby mode shall start and/or align to the operating mode.

(4) RSW System Divisions A and B shall have control interfaces with the Remote Shutdown System (RSS) as required to support RSW operation during RSS design basis conditions.

(5) If required by the elevation relationships between the UHS and the RSW System components in the Control Building (C/B), the RSW System shall have antisiphen capability to prevent a C/B flood after an RSW System break and after the RSW System pumps have been stopped.

(6) RSW System pumps in any division shall be tripped on receipt of a signal indicating flooding in that division of the C/B basement area.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.11.9 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the portions of the RSW System within the Certified Design.

(7) Any tunnel structures used to route RSW System piping to the Control Building shall be classified as Seismic Category 1. Tunnel flooding due to site flood conditions shall be precluded.

For material properties and dimensions, assess compliance of the as-built structure with design requirements in the Subsection 3.8.2 and in the detail design documents.

Construction deviations and design changes will be assessed to determine appropriate disposition.

This disposition will be accepted "as-is," provided the following acceptance criteria are met:

- The structural design meets the acceptance criteria and load combinations of Subsection 3.8.2.
- The dynamic responses (i.e., spectra, shear forces, axial forces and moments) of the as-built structure are bounded by the spectra in Appendices 3A and 3G.

Depending upon the extent of the deviation or design changes, compliance with the acceptance criteria can be determined by either:

(a) Analyses or evaluations of construction deviations and design changes, or

(b) The design basis analyses will be repeated using the as-built condition.

3H.5.3 Structural Analysis Report For The Reactor Building, Control Building and Radwaste Building Substructure (including Seismic Category 1 Tunnels)

A structural analysis report will be prepared. It will document the following activities associated to the construction materials and as-built dimensions of the building:

(1) Review of construction records for material properties used in construction (i.e., in-process testing of concrete properties and procurement specifications for structural steel and reinforcing bars).

(2) Inspection of as-built building dimensions.

For material properties and dimensions, assess compliance of the as-built structure with design requirements in the Subsection 3.8.4 and in the detail design documents.

Construction deviations and design changes will be assessed to determine appropriate disposition.

This disposition will be accepted "as-is," provided the following acceptance criteria are met:

- The structural design meets the acceptance criteria and load combinations of Subsection 3.8.4.

GE Nuclear Energy

ABWR

Date 2/11/94

To TOM BOYCE NRC WHITE FLINT Fax No. –
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Subject PIPING DAC

Message

TOM

ATTACHED ARE THE EQ ADDERS WE DISCUSSED

AJJ 2/11/94

(PROPOSED CHANGES - ACRS CONCERNS)

3.3 Piping Design

Design Description

Piping associated with fluid systems is categorized as either nuclear safety-related (i.e., Seismic Category I) or non-nuclear safety (NNS) related (i.e., non-Seismic Category I). The piping shall be designed for a design life of 60 years. Piping systems that must remain functional during and following a safe shutdown earthquake (SSE) are designated as Seismic Category I and are further classified as ASME Code Class 1, 2 or 3. The piping design requirements identified in this section encompass piping systems classified as nuclear safety-related and unless otherwise specified in this description, piping systems means nuclear safety-related piping systems. Piping systems and their components are designed and constructed in accordance with the ASME Code requirements identified in the individual system Design Descriptions.

Piping systems shall be designed to meet their ASME Code class and Seismic Category I requirements. The ASME Code Class 1, 2 and 3 piping systems shall be designed to retain their pressure integrity and functional capability under internal design and operating pressures and design basis loads. Piping stresses due to static and dynamic loads shall be combined and calculated in accordance with the ASME Code and shall be shown to be less than the ASME Code allowables for each service level.

For ASME Code Class 1 piping systems, a fatigue analysis shall be performed in accordance with the ASME Code Class 1 piping requirements. Environmental effects shall be included in the fatigue analysis. The Class 1 piping fatigue analysis shall show that the ASME Code Class 1 piping fatigue requirements have been met.

For ASME Code Class 2 and 3 piping systems, piping stress ranges due to thermal expansion shall be calculated in accordance with the ASME Code Class 2 and 3 piping requirements. The piping stress analysis shall show that the ASME Code Class 2 and 3 piping thermal expansion stress range requirements have been met. For the ASME Code Class 2 and 3 piping systems and their components which will be subjected to severe thermal transients, the effects of these transients shall be included in the design.

Feedwater lines shall be designed for thermal stratification loads.

Piping systems shall be designed to minimize the effects of erosion/corrosion.

For those piping systems using ferritic materials as permitted by the design specification, the ferritic materials and fabrication processes shall be selected to ensure that the piping system is not susceptible to brittle fracture under the expected service conditions.

For those piping systems using austenitic stainless steel materials as permitted by the design specification, the stainless steel piping material and fabrication process shall be selected to reduce the possibility of cracking during service. Chemical, fabrication, handling, welding, and examination requirements that reduce cracking shall be met.

Piping system supports shall be designed to meet the requirements of ASME Code Subsection NF.

For piping systems, the pipe applied loads on attached equipment shall be calculated and shown to be less than the equipment allowable loads.

Analytical methods and load combinations used for analysis of piping systems shall be referenced or specified in the ASME Code Certified Stress Report. Piping systems and their supports shall be mathematically modeled to provide results for piping system frequencies up to the analysis cutoff frequency. Computer programs used for piping system dynamic analysis shall be benchmarked.

Systems, structures and components that shall be required to be functional during and following an SSE shall be protected against the dynamic effects associated with postulated high energy pipe breaks in Seismic Category I and NNS piping systems. In addition, structures, systems, and components that shall be required to be functional during and following an SSE shall be protected against the environmental effects of spraying, flooding, pressure and temperature due to postulated pipe breaks and cracks in Seismic Category I and NNS piping systems. Each postulated piping failure shall be documented in a Pipe Break Analysis Report which concludes the reactor can be shut down safely and maintained in a safe, cold shutdown condition without offsite power. The Pipe Break Analyses Report shall specify the criteria used to postulate breaks and the analytical methods used to perform the pipe break analysis. For postulated pipe breaks, the Pipe Break Analysis Report shall confirm: (1) piping stresses in the containment penetration area shall be within their allowable stress limits, (2) pipe whip restraints and jet shield designs shall be capable of mitigating pipe break loads, ~~and~~ (3) loads on safety-related systems, structures and components shall be within their design loads limits. Piping systems that are qualified for leak-before-break design may exclude design features to mitigate the dynamic effects from postulated high energy pipe breaks.

or qualified to withstand

Piping systems shall be designed to provide clearance from structures, systems, and components where necessary for the accomplishment of the structure, system, or component's safety function as specified in the respective structure or system Design Description.

The as-built piping shall be reconciled with the piping design required by this section.

Insert Ⓑ

Insert Ⓑ

, and (4) safety-related piping required to be functional during and following an SSE are protected against or qualified to withstand the environmental conditions that would exist without loss of it's ~~safety~~ function for the time needed to be functional.

TU AL
2/4/94

Inspections, Tests, Analyses and Acceptance Criteria

Table 3.3 provides a definition of the inspections, tests, analyses, and associated acceptance criteria, which will be performed for ABWR nuclear safety-related and NNS related piping systems~~, as specified in each system's Design Description~~. Table 3.3 may be completed on an individual system basis.

Piping classification information is provided in the individual CDM entry for each of the piping systems. Furthermore,