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June 21, 2010

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-10175

Subject: MHI's Responses to US-APWR DCD RAI No. 579-4481 Revision 2

References: 1) "Request for Additional Information No. 579-4481 Revision 2, SRP Section: 03.04.01 – Internal Flood Protection for Onsite Equipment Failures, Application Section: 3.4.1," dated April 28, 2010.
2) "MHI's Responses to US-APWR DCD RAI No. 579-4481 Revision 2, UAP-HF-10149," dated May 27, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled, "Response to Request for Additional Information No. 579-4481 Revision 2".

Enclosed are the responses to the four (4) RAIs contained within Reference 1. They are RAI 3.4.1-24, 26, 27, and 28. Other four (4) RAI responses contained within Reference 1 were previously provided in Reference 2.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosure:

1. Responses to Request for Additional Information No. 579-4481 Revision 2

D081
NRO

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-10175
Docket No. 52-021

Responses to Request for Additional Information
No. 579-4481 Revision 2

June, 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/21/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 0579-4481 REVISION 2

SRP SECTION: 03.04.01 – Internal Flood Protection for Onsite Equipment Failures

APPLICATION SECTION: 03.04.01

DATE OF RAI ISSUE: 04/28/2010

QUESTION NO.: 03.04.01-24

In the amended May 21,2009 response to request for information (RAI) Question No.3.4.1-11, Mitsubishi provided a list of systems, structures, and components (SSCs) inside the containment annulus that require flood protection and the location of these SSCs relative to the flood level. However, Mitsubishi did not provide a description of instrumentation for flood detection, as was requested in RAI Question 3.4.1-11.

As discussed in SRP 3.4.1, Section II, "Acceptance Criteria," General Design Criteria (GDC) 2 requires in part that "structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as ... floods ... without loss of capability to perform their safety functions." Meeting the requirements of GDC 2 includes evaluating the effects of flooding from full circumferential failures of non-seismic, moderate-energy piping. As also discussed in Standard Review Plan (SRP) 3.4.1, Section II, "Acceptance Criteria," the requirements of GDC 4 relate to SSCs important to safety being designed to accommodate the effects of environmental conditions associated with postulated accidents, including loss-of-coolant accidents. Meeting the requirements of GDC 4 includes ensuring that SSCs important to safety are protected from potential flooding from liquid-carrying components in the plant.

Describe and demonstrate the adequacy of instrumentation for flood detection within the containment annulus. Include this information in the Design Control Document (DCD), identify which revision will include the change, and provide a markup in your response.

Reference: Amended MHI's Responses to US-APWR DCD RAI No. 220-2058; MHI Ref: UAP-HF-09251; Dated May 21, 2009; ML091480377.

ANSWER:

The safety-related SSCs that require flood protection inside the containment annulus are listed in Table 3K. Instrumentation for flood detection is installed in the containment annulus compartment since the compartment houses mechanical penetrations including piping systems containing water. The instrumentation is designed to alarm when the annulus compartment is flooded.

MHI will revise the DCD to state that instrumentation for flood detection is installed inside of the containment annulus. This information will be included in the next DCD revision.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.4, changes to be incorporated.

- Add the following as a new paragraph included in the Bullet for "R/B RCA" in the last paragraph in Section 3.4.1.3:

  "Instrumentation for flood detection is installed in the containment annulus compartment since the compartment houses mechanical penetrations including piping systems containing water. The instrumentation is designed to alarm when the annulus compartment is flooded."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/21/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 0579-4481 REVISION 2**

SRP SECTION: **03.04.01 – Internal Flood Protection for Onsite Equipment Failures**

APPLICATION SECTION: **03.04.01**

DATE OF RAI ISSUE: **04/28/2010**

QUESTION NO.: 03.04.01-26

In the amended May 21, 2009 response to request for information (RAI) Question No.3.4.1-16, Mitsubishi provided a list of SSCs inside the power source buildings (PS/B) that require flood protection and the location of these SSCs relative to the flood level. However, Mitsubishi did not demonstrate how safety-related SSCs located in the PS/B are protected from internal flood, as was requested in RAI Question 3.4.1-16.

As discussed in Standard Review Plan (SRP) 3.4.1, Section II, "Acceptance Criteria," General Design Criteria (GDC) 2 requires in part that "structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as ... floods ... without loss of capability to perform their safety functions." Meeting the requirements of GDC 2 includes evaluating the effects of flooding from full circumferential failures of non-seismic, moderate-energy piping. As also discussed in SRP 3.4.1, Section II, "Acceptance Criteria," the requirements of GDC 4 relate to SSCs important to safety being designed to accommodate the effects of environmental conditions associated with postulated accidents, including loss-of-coolant accidents. Meeting the requirements of GDC 4 includes ensuring that SSCs important to safety are protected from potential flooding from liquid-carrying components in the plant. In accordance with SRP 3.4.1, Section I, "Areas of Review," there are a number of specific areas that should be reviewed, including SSCs that could be sources of internal flooding, the adequacy of flood isolation, provisions for protection against possible inleakage sources, and design features used to mitigate the effects of internal flooding.

Demonstrate how safety-related SSCs located in the PS/B are protected from internal flood. Specifically address the review items listed in SRP 3.4.1, Section I, "Areas of Review," including SSCs that could be sources of internal flooding, the adequacy of flood isolation, provisions for protection against possible in-leakage sources, and design features used to mitigate the effects of internal flooding. Describe how the worst case flooding sources were identified, and describe instrumentation used for flood detection. Include this information in the Design Control Document (DCD), identify the revision in which it will be included, and provide a markup in your response.

Reference: Amended MHI's Responses to US-APWR DCD RAI No. 220-2058; MHI Ref: UAP-HF-09251; Dated May 21, 2009; ML091480377.

ANSWER:

MHI will include a description within the next DCD revision that describes how the worst case flooding sources were identified and how safety-related SSCs located in the PS/Bs are protected from internal flooding.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2 Section 3.4, to be incorporated as a new subsection in the DCD:

- Add new Subsection 3.4.1.5.3:
  "3.4.1.5.3 Reactor Building Flooding Events Impacting PS/B"

  The US-APWR PS/B includes an east and west PS/B that are adjoined by the NRCA of R/B.

  The doorways provide potential flow paths from the NRCA of R/B to the PS/B. These flooding events are evaluated on a compartment basis.

  All floors in the NRCA of the R/B are divided into two areas, east and west, by concrete walls and/or water-tight doors. The floor drain water is also routed to the non-radioactive drain sump at elevation -26 ft, 4 in. The floor drains of the east areas are connected and finally go into the A-R/B non-radioactive sump. The floor drains of west areas are connected and finally go into the B-R/B non-radioactive sump. There is no cross-connection between east and west area drains. Therefore, east and west areas are evaluated as independent areas.

  Elevation -26 ft, 4 in.

  The equipment to be protected in the east area of PS/B at elevation -26 ft, 4 in. are the A and B train Essential Chiller Units. Equipment to be protected in the west area are the C and D train Essential Chiller Units.

  In both the east and west area, each area is isolated by a fire rated door instead of a water-tight door. Therefore, flood water is assumed to run across the entire area. In addition, the door to the adjoined NRCA of R/B is not a water-tight door, and the flood water from NRCA R/B is assumed to run across the PS/B.

  Flood Events are considered as follows;

  - Earthquake

    In the flooding events caused by an earthquake, the following components are assumed to fail and release all of their contents:

    - Non-seismic category I piping in the NRCA of the R/B, total volume of water held by these pipe lines is 700 ft^3.
    - Non-seismic category I components in the adjacent A/B are considered damaged. Water from these failed components is conservatively assumed to flow to the NRCA portion of the R/B through floor drains. The components in these buildings which are not seismic category I are associated with the demineralized water system, and non-safety chilled water system. The total volume of water held by these systems is 1,590 ft^3. Since floor drains of the NRCA of the A/B are collected by non-radioactive drain sump, the water of these areas does not flow into the east area. Therefore, the water generated in

the NRCA of the A/B is taken into consideration in the evaluation of the west area.

- HELB/MELB

  HELB event is not a concern, because there are no piping breaks, which are assumed to occur in the subject area.

- Fire Fighting Operations

  The flooding contribution from fire fighting operations is based on the full operation of two hose stations for 2 hours. The flow rate from one hose station is 125 gpm. With two stations operating for 2 hours, the total volume of water is 4,010 ft^3.

Based on the flood events described above, the worst case results are from a combination of earthquake and fire fighting operations. The total volume of flood water caused by this combination is as follows:

- East side: 4,710 ft^3
- West side: 6,300 ft^3

The square footage of floor area subject to flooding at elevation -26 feet, 4 inches is as follows:

- East side: 10,500 ft^2 (this area includes R/B NRCA floor area)
- West side: 10,500 ft^2 (this area includes R/B NRCA floor area)

Based on these values, the maximum water level is as follows:

- East side: 0.45 ft above elevation -26 ft, 4 in.
- West side: 0.60 ft above elevation -26 ft, 4 in.

The pump foundations (top of concrete) height is 1.0 foot above floor elevation -26 ft, 4 in. As such, the pumps are not flooded. The instrumentation of each pump is designed to be located at heights above the level of flood water.

Elevation 3 ft, 7 in.

The equipment to be protected in the east area of PS/B at elevation 3 ft, 7 in. are the A and B train Class 1E GTG. Similarly, the equipment to be protected in the west area is the C and D train Class 1E GTG. The Class 1E GTG rooms are isolated from corridor of R/B NRCA by concrete walls and water-tight door. There are no floor drains in the Class 1E GTG rooms.

Flood events are considered as follows:

- Earthquake

The total water volume from the earthquake event is same as that of elevation -26 ft, 4 in.

- HELB/MELB

HELB event is not a concern, because there are no piping breaks, which are assumed to occur in the subject area.

- Fire Fighting Operations

The total water volume from the fire fighting operation events is same as that of elevation -26 ft, 4 in.

Based on the flood events described above, the worst case results are from a combination of earthquake and fire fighting operations. The total volume of flood water caused by this combination is 4,710 ft^3 in both the east and west area.

The footage of corridor area and the water level are as follows:

- East side: 1,500 ft^2 area, 3.14 ft above elevation 3 ft, 7 in.
- West side:1,500 ft^2 area, 3.14 ft above elevation 3 ft, 7 in.

Class 1E GTG are installed in the room which prevents flow-in water by water-tight door.

Therefore, GTG room is not flooded."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/21/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 0579-4481 REVISION 2**

SRP SECTION: **03.04.01 – Internal Flood Protection for Onsite Equipment Failures**

APPLICATION SECTION: **03.04.01**

DATE OF RAI ISSUE: **04/28/2010**

QUESTION NO.: 03.04.01-27

In response to request for information (RAI) Question No. 3.4.1-17, Mitsubishi stated that several means are used to assure the functionality of watertight doors, including remote indication of door positions provided to operators, and periodic visual inspections and functional tests. Mitsubishi proposes to revise the Tier 2 Design Control Document (DCD) Section 3.4.1.3 to include a brief discussion that outlines this approach. However, in the proposed revision to the Tier 2 DCD, Mitsubishi makes reference to door "position indication" instead of door "remote position indication." Furthermore the Tier 2 DCD does not indicate that remote position indication is available to operators. The ability of operators to remotely monitor the position of watertight doors is important in assuring door functionality.

In accordance with Standard Review Plan (SRP) 3.4.1, Item III.2, the staff is to review the adequacy of techniques used to prevent flooding, including the use of watertight doors. Propose an update to DCD Section 3.4.1.3 that includes incorporation of the information provided in the RAI response for Question 3.4.1-17 concerning the provisions allowing for remote position indication for the watertight doors by operators. Indicate in which revision the update will be included and provide a markup in your response.

Reference: Amended MHI's Responses to US-APWR DCD RAI No. 220-2058; MHI Ref: UAP-HF-09251; Dated May 21, 2009; ML091480377.

ANSWER:

MHI stated in the reply to Question 3.4.1-17 that several means are used to assure the function of water-tight doors. Remote Position Indication is provided to the operators for verification that the doors are in the proper position for the plant condition. The alarm is indicated if the doors are not in the proper position for the plant condition.

MHI will revise the description in the next DCD revision (Tier 2, Section 3.4.1.3) to state "remote position indication" in place of "position indication".

Impact on DCD

See Attachment 1 for mark-up of DCD Tier 2, Section 3.4, changes to be incorporated.

- Change the second sentence of the fourth paragraph of Subsection 3.4.1.3 to read as follows:

  "Water-tight doors have remote position indication for closure verification and are periodically inspected and tested to ensure proper functionality."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/21/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 0579-4481 REVISION 2**

SRP SECTION: **03.04.01 – Internal Flood Protection for Onsite Equipment Failures**

APPLICATION SECTION: **03.04.01**

DATE OF RAI ISSUE: **04/28/2010**

QUESTION NO.: 03.04.01-28

In response to request for RAI Question 3.4.1-18, Mitsubishi stated that the design will preclude submergence of components that require active operation to achieve safety functions. This design constraint applies to both the design certification (DC) and combined license (COL) application stages. Mitsubishi further states that there are other safety-related systems, structures, and components (SSCs) that are permitted to be submerged and environmentally protected as described in Tier 2 DCD Section 3.11. However, Tier 2 DCD Section 3.11 and its associated tables (e.g., Table 3D-2, "US-APWR Environmental Qualification Equipment List") do not explicitly identify those components that are credited for operation while being submerged. It is noted that Mitsubishi's responses to RAI Questions 3.4.1-02, and 3.4.1-05 identify instances in which credit was taken for submergence of safety-related SSCs in the PCCV and the NRCA portion of the R/B. However, it is not clear that Mitsubishi has identified all instances in which credit was taken for a submerged SSC (e.g., there does not appear to be any instance of credit taken for a submerged SSC located outside of the PCCV and the NRCA portion of the R/B). Furthermore, Mitsubishi does not explain how the DCD will ensure that the COL applicant will address the operability of submerged SSCs that do not require active operation.

Per Standard Review Plan (SRP) Section 3.4.1, Item III.5, safety-related SSCs being located below the flood level should be reviewed, and therefore, should be identified in the DCD. Also, it must be demonstrated that these SSCs are capable of their normal function while submerged.

Explicitly identify all of the safety-related SSCs that are credited for operation while being submerged and demonstrate how these SSCs will retain their normal function while submerged. Also, explain how the DCD will ensure that the COL applicant will address the operability of submerged SSCs that do not require active operation. Include this information in the DCD, identify in which revision it will be included, and provide a markup in your response.

References:
MHI's Responses to US-APWR DCD RAI No. 220-2058; MHI Ref: UAP-HF-09152; Dated April 8, 2009; ML091030066.
Amended MHI's Responses to US-APWR DCD RAI No. 220-2058; MHI Ref: UAP-HF-09251; Dated May 21, 2009; ML091480377.

ANSWER:

All of the safety-related SSCs that are credited for operation while being submerged are listed in Table 3K. The SSCs that are submerged in a flooding event are identified in Table 3K.

The SSCs that are submerged in a flooding event are the Reactor Vessel, Source Range Neutron Flux Detector, Power Range Neutron Flux Detector, Main Feed Water Isolation Valves, Component Cooling Water Surge Tank and Level Control Valves, and associated piping.

The notes of Table 3K include information on how these components retain their functions when submerged. Note 3 and Note 7 will be revised to contain more information.

SSCs are designed, constructed, and maintained to assure their capability to perform required functions under normal, transient and post-accident conditions. SSCs that are subject to postulated flooding conditions are qualified to assure that the anticipated service and environmental conditions do not adversely affect their ability to perform required functions or adversely affect the ability of the plant to achieve and maintain a safe shutdown condition.

MHI will revise the DCD in the next revision to state how safety-related SSCs maintain their function, even if they are submerged.

Impact on DCD

See Attachment 2 for mark-up of DCD Tier 2, Appendix 3K, changes to be incorporated.

- Table 3K-3 Note 3
  "Main feed water valves are submerged in the event of main feed water pipe rupture. However, the function of these valves are not required for the mitigation of a main feed water pipe rupture event. Main feed water valves are required for containment isolation function in the event of LOCA. In the event of LOCA, a huge volume of water is released. However, this flooding only occurs inside containment. Therefore, these valves are not submerged in the event of LOCA."

- Table 3K-3 Note 7
  "These valves are closed when in the normal condition. If this valve opens due to a flooding event, the water is continuously supplied to CCW surge tank. Then, the surge tank may fail. However, the other valve "NCS-RCV-056B" will open on a high water level alarm. Since the valve "NCS-RCV-056B" is not submerged in the event of flooding, the CCW surge tank maintains its function."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

This completes MHI's responses to the NRC's questions.

- Pipe breaks and cracks
- Fire fighting operations
- Pump mechanical seal failures

The combination of events is not considered. However, an earthquake event followed by fire fighting operations for an earthquake induced fire is considered.

For flood events caused by an earthquake, equipment or pipe (not classified as seismic category I) in the R/B are assumed to be fully compromised and the total volume of the fluid contained within the subject equipment or pipe contributes to the flood volume. Equipment or piping not classified as seismic category I in areas outside of the area of concern is also assumed to be fully compromised, and if the discharge fluids can not be demonstrated to be excluded from the area of concern, their volume is included in the flood volume. The US-APWR is designed for maximum water levels created by internal flooding sources. The internal flood design accommodates the effects of, and is compatible with, environmental conditions associated with normal operations, maintenance, testing, and postulated accidents, including LOCAs.

Water-tight doors are used as protective barriers to prevent flood waters from spreading to adjacent divisions in various buildings and elevations. Water-tight doors have remote position indication for closure verification and are periodically inspected and tested to ensure proper functionality.

Open pits are isolated within water tight compartments using water tight doors, penetration seals, and normally closed floor drains. In this manner, flooding effects caused by open pit water sloshing are considered.

For flood events caused by the postulated failure of piping, defined in Section 3.6, the rupture of the single worst-case piping in the area of concern is assumed in the flood analysis for each area of concern. The discharge volume is calculated according to "Subcompartment Pressure and Temperature Transient Analysis in Light Water Reactors", American National Standards Institute (ANSI)/American Nuclear Society (ANS) 56.10-1987, Section 3 (Reference 3.4-6), and is included in the pipe break and cracks flood evaluation. The structures adjacent to the postulated pipe rupture locations are also designed for the maximum associated hydrodynamic loads due to a pipe failure as discussed in Section 3.6. The loads and load combinations are addressed in detail in Section 3.8.

In the flooding effects from fire fighting operations, water discharged from only fire hose stations is assumed. In fire fighting operations, a discharge rate of 125 gpm is assumed for a period of 2 hours from two hose stations.

Pump mechanical seal failures of concern are limited to the active pumps identified in Section 3.9. Seal failure is a low probability event based on the use of robust pump mechanical seals. Additionally, monitoring of mechanical seal water temperature, pressure, and flow rate across the pump mechanical seals provides the means of limiting the effects of pump seal failure through early detection and timely corrective action. As such, pump mechanical seal failure presents a sufficiently low probability of occurrence and flood volume that it can be credibly ignored.

ATTACHMENT 1
to RAI 579-4481

The formulae and methodology of "Design Criteria for Protection against the Effects of Compartment Flooding in Light Water Reactor Plants", ANSI/ANS-56.11-1988 (Reference 3.4-7) are used when analyzing flow rates through unusual features such as stairwells and floor/wall openings.

The areas of concern within the US-APWR are as follows:

- R/B
  - Inside the PCCV

    Systems to be protected within the PCCV are the RCS, the safety injection system (SIS), RHRS, the CSS, and the containment boundary.

    The components to be protected from flooding in the protected systems are the motor operated components, such as valves and electric/instrumentation components.

  - Outside the PCCV

    US-APWR R/B consists of a radiological controlled area (RCA) and a non-radiological controlled area (NRCA) separated physically by concrete barrier walls. These concrete barrier walls are designed to preclude flooding between the RCA and the NRCA. Piping, instrumentation, HVAC duct, conduit, and cable trays installed through a flood barrier wall are routed above the maximum flood level or provided with water-tight seals.

    - R/B RCA

      Systems to be protected in the RCA of the R/B are the SIS, the RHRS, the CSS, the containment boundary, the safeguard component area the HVAC system, and the annulus air clean up system.

      In the systems to be protected, the components to be protected from flooding are the motor driven pumps, the valves, and the HVAC fans and dampers, the electric panels, and the electric/instrumentation components within the relevant system.

      Instrumentation for flood detection is installed in the containment annulus compartment since the compartment houses mechanical penetrations including piping systems containing water. The instrumentation is designed to alarm when the annulus compartment is flooded.

    - R/B NRCA

      The NRCA of the R/B adjoins the east and west PS/Bs and the T/B, with personnel access between all three areas.

      The systems to be protected in the NRCA of the R/B are the CCWS, the emergency feedwater system (EFWS), the electrical panels, the Class 1E electric/instrumentation components, and the HVAC fans and dampers for these systems.

The total water volume from the fire fighting operation events is same as that of elevation -26 ft, 4 in.

Based on the flood events described above, the worst case results are from a combination of earthquake and fire fighting operations. The total volume of flood water caused by this combination is 4,710 ft^3 in both the east and west area.

The footage of subject area and the water level are as follows;

- East side: 3,150 ft^2 area, 1.50 ft above elevation 76 ft, 5 in.

- West side: 3,800 ft^2 area, 1.24 ft above elevation 76 ft, 5 in.

The instrumentation of the EFW pit is designed to be located at heights above the level of flood water. The remote shutdown console is installed in the remote shutdown room. There is no piping and therefore no flooding sources inside the remote shutdown room. In addition, the remote shutdown room is protected from in-flow of water from flood sources by a water-tight door.

3.4.1.5.3 Reactor Building Flooding Events Impacting PS/B

The US-APWR PS/B includes an east and west PS/B that are adjoined by the NRCA of R/B.

The doorways provide potential flow paths from the NRCA of R/B to the PS/B. These flooding events are evaluated on a compartment basis.

All floors in the NRCA of the R/B are divided into two areas, east and west, by concrete walls and/or water-tight doors. The floor drain water is also routed to the non-radioactive drain sump at elevation -26 ft, 4 in. The floor drains of the east areas are connected and finally go into the A-R/B non-radioactive sump. The floor drains of west areas are connected and finally go into the B-R/B non-radioactive sump. There is no cross-connection between east and west area drains. Therefore, east and west areas are evaluated as independent areas.

Elevation -26 ft, 4 in.

The equipment to be protected in the east area of PS/B at elevation -26 ft, 4 in. are the A and B train Essential Chiller Units. Equipment to be protected in the west area are the C and D train Essential Chiller Units.

In both the east and west area, each area is isolated by a fire rated door instead of a water-tight door. Therefore, flood water is assumed to run across the entire area. In addition, the door to the adjoined NRCA of R/B is not a water-tight door, and the flood water from NRCA R/B is assumed to run across the PS/B.

Flood Events are considered as follows;

- Earthquake

  In the flooding events caused by an earthquake, the following components are assumed to fail and release all of their contents:

ATTACHMENT 1
to RAI 579-4481

- Non-seismic category I piping in the NRCA of the R/B, total volume of water held by these pipe lines is 700 ft^3.

- Non-seismic category I components in the adjacent A/B are considered damaged. Water from these failed components is conservatively assumed to flow to the NRCA portion of the R/B through floor drains. The components in these buildings which are not seismic category I are associated with the demineralized water system, and non-safety chilled water system. The total volume of water held by these systems is 1,590 ft^3. Since floor drains of the NRCA of the A/B are collected by non-radioactive drain sump, the water of these areas does not flow into the east area. Therefore, the water generated in the NRCA of the A/B is taken into consideration in the evaluation of the west area.

- HELB/MELB

  HELB event is not a concern, because there are no piping breaks, which are assumed to occur in the subject area.

- Fire Fighting Operations

  The flooding contribution from fire fighting operations is based on the full operation of two hose stations for 2 hours. The flow rate from one hose station is 125 gpm. With two stations operating for 2 hours, the total volume of water is 4,010 ft^3.

Based on the flood events described above, the worst case results are from a combination of earthquake and fire fighting operations. The total volume of flood water caused by this combination is as follows:

- East side: 4,710 ft^3

- West side: 6,300 ft^3

The square footage of floor area subject to flooding at elevation -26 feet, 4 inches is as follows:

- East side: 10,500 ft^2 (this area includes R/B NRCA floor area)

- West side: 10,500 ft^2 (this area includes R/B NRCA floor area)

Based on these values, the maximum water level is as follows:

- East side: 0.45 ft above elevation -26 ft, 4 in.

- West side: 0.60 ft above elevation -26 ft, 4 in.

The pump foundations (top of concrete) height is 1.0 foot above floor elevation -26 ft, 4 in. As such, the pumps are not flooded. The instrumentation of each pump is designed to be located at heights above the level of flood water.

Elevation 3 ft, 7 in.

The equipment to be protected in the east area of PS/B at elevation 3 ft, 7 in. are the A and B train Class 1E GTG. Similarly, the equipment to be protected in the west area is the C and D train Class 1E GTG. The Class 1E GTG rooms are isolated from corridor of R/B NRCA by concrete walls and water-tight door. There are no floor drains in the Class 1E GTG rooms.

Flood events are considered as follows:

- Earthquake

  The total water volume from the earthquake event is same as that of elevation -26 ft, 4 in.

- HELB/MELB

  HELB event is not a concern, because there are no piping breaks, which are assumed to occur in the subject area.

- Fire Fighting Operations

  The total water volume from the fire fighting operation events is same as that of elevation -26 ft, 4 in.

Based on the flood events described above, the worst case results are from a combination of earthquake and fire fighting operations. The total volume of flood water caused by this combination is 4,710 ft^3 in both the east and west area.

The footage of corridor area and the water level are as follows:

- East side: 1,500 ft^2 area, 3.14 ft above elevation 3 ft, 7 in.

- West side:1,500 ft^2 area, 3.14 ft above elevation 3 ft, 7 in.

Class 1E GTG are installed in the room which prevents flow-in water by water-tight door. Therefore, GTG room is not flooded.

3.4.2 Analysis Procedures

The static and dynamic effects of the design-basis flood or groundwater conditions, which are identified in Section 2.4, are applied to seismic category I structures. Section 3.8 specifies the applicable codes, standards, and specifications used in the design of seismic category I structures. The loads and load combination subsections of Section 3.8 take into consideration the static and dynamic loadings on seismic category I structures including hydrostatic loading as the result of the design-basis flood and/or ground conditions identified in Section 2.4. Section 3.8 also provides the design and analysis procedures used to transform the static and dynamic effects of the DBFL and ground water levels applied to seismic category I structures to assure their design meet the applicable acceptance criteria.

The COL Applicant is to identify any site-specific physical models used to predict prototype performance of hydraulic structures and systems involving an unusual design or configuration, or for a design or operating bases involving thermal and erosion problems.

Table 3K-3 R/B NRCA Components Protected From Internal Flooding (Sheet 30 of 30)

Notes:

1. These components are protected by water-tight door and floor drain isolation valve against in-flow of flooding occurring outside of compartment. In addition, these components are not required to be protected against flooding occurring inside the compartment due to redundancy of other trains/components.
2. There is no impact to this component, even if outside of pit is flooded.
3. ~~These components are not required for safe shutdown. In addition, the function of containment isolation is maintained due to installation areas of these components are not flooded during LOCA.~~ Main feed water valves are submerged in the event of main feed water pipe rupture. However, the function of these valves are not required for the mitigation of a main feed water pipe rupture event. Main feed water valves are required for containment isolation function in the event of LOCA. In the event of LOCA, a huge volume of water is released. However, this flooding only occurs inside containment. Therefore, these valves are not submerged in the event of LOCA.
4. Support leg of A-CCW surge tank is flooded, but there is no impact to function of this component.
5. Lower portion of B-CCW surge tank is flooded, but there is no impact to function of this component.
6. These components are protected by water-tight door against in-flow of flooding occurring outside of compartment.
7. ~~This valve is required to maintain function of CCW surge tank. However, function of CCW surge tank can be maintained by other non-flooded valves, even if this valve is flooded.~~ These valves are closed when in the normal condition. If this valve opens due to the event of flooding, the water is continuously supplied to CCW surge tank. Then, the surge tank may fail. However, the other valve "NCS-RCV-056B" will open on a high water level alarm. Since the valve "NCS-RCV-056B" is not submerged in the event of flooding, the CCW surge tank maintains its function.