REQUEST FOR ADDITIONAL INFORMATION 220-2058 REVISION 1

2/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 03.04.01 - Internal Flood Protection for Onsite Equipment Failures
Application Section: 3.4.1

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

03.04.01-1

RAI 3.4.1-01

It is stated in DCD Tier 1 Sections 1.2 and 3.1, that the standard plant design includes the following set of buildings and structures: reactor building (R/B), which includes the prestressed concrete containment vessel (PCCV) and containment internal structure (CIS); power source buildings (PS/Bs); auxiliary building (A/B); turbine building (T/B); access building (AC/B); power source fuel storage vaults (PSFSVs); and essential service water pipe tunnel (ESWPT). However, DCD Tier 2 Section 3.8.4 states that the PSFSVs, the ESWPT, and the ultimate heat sink related structures (UHSRS) are not part of the standard design. Thus, DCD Tier 1 Sections 1.2 and 3.1, and Tier 2 Section 3.8.4 appear to provide conflicting information as to whether the PSFSVs and the ESWPT are included in the standard plant design. To support the staff's review of internal flood protection for the US-APWR, it is necessary that the applicant clearly identify the set of structures, systems, and components (SSCs) associated with the standard plant design.

Clearly identify the set of buildings and SSCs associated with the standard plant design. Include this information in the DCD and provide a markup in your response.

03.04.01-2

RAI 3.4.1-02

DCD Tier 1, Table 2.2-3, "Main Components Protected against External Floods, Internal Floods and Internal Fires," and DCD Tier 2, Sections 3.4.1.3 and 3.4.1.5.1 identify SSCs that require protection from internal flood according to specific buildings or building areas, including SSCs located inside the prestressed concrete containment vessel (PCCV). It is not clear that the DCD has identified a complete set of SSCs located inside the PCCV that must be protected from flood. For example, the DCD does not identify SSCs inside the PCCV that provide safety-related electrical power, monitoring, and actuation functions.

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." SRP Section 3.4.1, Acceptance Criteria 1 states that acceptable guidance for meeting the seismic design and classification requirements of GDC 2 is provided in Regulatory Guide (RG) 1.29, "Seismic Design Classification," Revision 4, March 2007, Position C.1 for safety-related SSCs and Position C.2 for nonsafety-related SSCs. For example, equipment required for monitoring and actuating systems important to safety should be protected as indicated in Position C.1 of RG 1.29, Item (k). Also, Class 1E electrical systems that provide emergency power for functioning of plant features should be protected as indicated in Position C.1 of RG 1.29, Item (q). In addition, per SRP 3.4.1, Item I.1, the set of SSCs that must be protected from flooding should be reviewed, and therefore, should be identified in the DCD.

Provide a complete list of SSCs located within the PCCV that require protection from internal flooding. Include this information in the DCD and provide a markup in your response.

03.04.01-3

RAI 3.4.1-03

In DCD Tier 2, Section 3.4.1.5.2.1, p. 3.4-15, it is stated that equipment items to be protected in the radiological controlled area (RCA) of the reactor building (R/B) at elevation 76 ft, 5 in. are "junction boxes and cables in electrical penetration room isolation valves." This statement is not clear.

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." Per SRP 3.4.1, Item I.1, the set of SSCs that must be protected from flooding should be reviewed, and therefore, should be identified in the DCD. The DCD has not clearly identified this information for the staff to review.

Clarify the DCD statement quoted above. Include this information in the DCD and provide a markup in your response.

03.04.01-4

RAI 3.4.1-04

DCD Tier 1, Table 2.2-3, "Main Components Protected against External Floods, Internal Floods and Internal Fires," and DCD Tier 2, Sections 3.4.1.3 and 3.4.1.5.2.1 identify SSCs that require protection from internal flooding according to specific buildings or building areas, including SSCs located inside the Radiological Controlled Area (RCA) of the Reactor Building (R/B). It is not clear that the DCD has identified a complete set of SSCs located inside the RCA portion of the R/B that must be protected from flooding.

For example, the DCD does not identify SSCs inside the RCA that provide safety-related monitoring and actuation functions.

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." SRP Section 3.4.1, Acceptance Criteria 1 states that acceptable guidance for meeting the seismic design and classification requirements of GDC 2 can be based on meeting Regulatory Guide (RG) 1.29, "Seismic Design Classification," Revision 4, March 2007, Position C.1 for safety-related SSCs and Position C.2 for nonsafety-related SSCs. For example, systems required for monitoring and actuating systems important to safety should be protected as indicated in Position C.1 of RG 1.29, Item (k). Also, per SRP 3.4.1, Item I.1, the set of SSCs that must be protected from flooding should be reviewed, and therefore, should be identified in the DCD.

Provide a complete list of SSCs located within the RCA portion of the R/B that require protection from internal flooding. Include this information in the DCD and provide a markup in your response.

03.04.01-5

RAI 3.4.1-05

DCD Tier 1, Table 2.2-3, "Main Components Protected against External Floods, Internal Floods and Internal Fires," and DCD Tier 2, Sections 3.4.1.3 and 3.4.1.5.2.2 identify SSCs that require protection from internal flood according to specific buildings or building areas, including SSCs located inside the Non-Radiological Controlled Area (NRCA) of the Reactor Building (R/B). It is not clear that the DCD has identified a complete set of SSCs located inside the NRCA portion of the R/B that must be protected from flood. For example, the DCD does not appear to identify all circuitry between the process and input terminals of actuator systems involved in protective actions.

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." SRP Section 3.4.1, Acceptance Criteria 1 states that acceptable guidance for meeting the seismic design and classification requirements of GDC 2 can be based on meeting Regulatory Guide (RG) 1.29, "Seismic Design Classification," Revision 4, March 2007, Position C.1 for safety-related SSCs and Position C.2 for nonsafety-related SSCs. For example, all circuitry between the process and input terminals of actuator systems involved in protective actions should be protected as indicated in Position C.1 of RG 1.29, Item (j). Also, per SRP 3.4.1, Item I.1, the set of SSCs that must be protected from flooding should be reviewed, and therefore, should be identified in the DCD.

Provide a complete list of SSCs located within the NRCA portion of the R/B that require protection from internal flood. Include this information in the DCD and provide a markup in your response

03.04.01-6

RAI 3.4.1-06

The DCD does not explicitly identify systems and components located within the power source buildings (PS/B) that require protection from internal flood. Per DCD Tier 2 Table 3.2-2, the PS/B contains some seismic Category I SSCs, including essential service water (ESW) valves, essential chiller pumps, and miscellaneous equipment related to the emergency gas turbines. The PS/B is included as part of the standard plant design.

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." SRP Section 3.4.1, Acceptance Criteria 1 states that acceptable guidance for meeting the seismic design and classification requirements of GDC 2 can be based on meeting Regulatory Guide (RG) 1.29, "Seismic Design Classification," Revision 4, March 2007, Position C.1 for safety-related SSCs and Position C.2 for nonsafety-related SSCs. Also, per SRP 3.4.1, Item I.1, the set of SSCs that must be protected from flooding should be reviewed, and therefore, should be identified in the DCD.

Provide a complete list of SSCs located within the PS/B that require protection from internal flood. Include this information in the DCD and provide a markup in your response.

03.04.01-7

RAI 3.4.1-07

The DCD does not explicitly identify systems and components located within the containment annulus that require protection from internal flood. The containment annulus is an element of the standard plant design. The containment annulus houses penetrations, including penetrations for piping systems. Flooding might occur following a break in these piping systems.

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." SRP Section 3.4.1, Acceptance Criteria 1 states that acceptable guidance for meeting the seismic design and classification requirements of GDC 2 can be based on meeting Regulatory Guide (RG) 1.29, "Seismic Design Classification," Revision 4, March 2007, Position C.1 for safety-related SSCs and Position C.2 for nonsafety-related SSCs. Also, per SRP 3.4.1, Item I.1, the set of SSCs that must be protected from flooding should be reviewed, and therefore, should be identified in the DCD.

Provide a complete list of SSCs located within the containment annulus that require protection from internal flood. Include this information in the DCD and provide a markup in your response.

03.04.01-8

RAI 3.4.1-08

The DCD does not explicitly identify the SSCs associated with spent fuel pit cooling that require protection from internal flood.

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." SRP Section 3.4.1, Acceptance Criteria 1 states that acceptable guidance for meeting the seismic design and classification requirements of GDC 2 can be based on meeting Regulatory Guide (RG) 1.29, "Seismic Design Classification," Revision 4, March 2007, Position C.1 for safety-related SSCs and Position C.2 for nonsafety-related SSCs. Also, per SRP 3.4.1, Item I.1, the set of SSCs that must be protected from flooding should be reviewed, and therefore, should be identified in the DCD.

Provide a complete list of SSCs associated with spent fuel pit cooling that require protection from internal flood. Include this information in the DCD and provide a markup in your response

03.04.01-9

RAI 3.4.1-09

The PCCV flooding analysis evaluates the maximum flooding event, which is identified as a LOCA. However, the DCD does not explain how the worst case flooding source was determined. There appear to be other potential sources of flood water inside the PCCV, for example component cooling water (CCW) and fire water as indicated in DCD Tier 2 Table 6.2.4-3, "List of Containment Penetrations and System Isolation Positions."

In accordance with SRP 3.4.1, Section I, Item 6, and Section III, Item 3, potential flooding sources should be reviewed, and therefore, should be identified in the DCD.

Explain how the worst case flooding source for the PCCV was determined. Include this information in the DCD and provide a markup in your response

03.04.01-10

RAI 3.4.1-10

With regard to the PCCV flooding analysis, the DCD states that components sensitive to flooding that are required to function are located above the flood elevation. However, the DCD does not identify the locations of safety-related SSCs relative to the internal flood level.

In accordance with SRP 3.4.1, Item I.2, the locations of safety-related SSCs relative to the internal flood level should be reviewed, and therefore, should be identified in the DCD.

Identify the locations of safety-related SSCs relative to the internal flood level. Include this information in the DCD and provide a markup in your response.

03.04.01-11

RAI 3.4.1-11

The containment annulus houses containment electrical and mechanical penetration areas. Mechanical penetrations include piping systems containing water. Flooding might occur following a break in these piping systems. However, the DCD does not describe how internal flood protection is achieved for safety-related SSCs located in the containment annulus.

As discussed in SRP 3.4.1, Section II, “Acceptance 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.

Demonstrate how safety-related SSCs located in the containment annulus are protected from internal flood, including a description of instrumentation for flood detection, in accordance with the acceptance criteria of SRP 3.4.1. Include this information in the DCD and provide a markup in your response.

03.04.01-12

RAI 3.4.1-12

DCD Tier 2 Sections 3.4.1.5.2.1 and 3.4.1.5.2.2 provide a series of flooding analyses were performed for both the RCA and NRCA portions of the R/B. In each case, the DCD states that equipment to be protected from flooding is "located at heights above the level of flood water." However, this statement could not be confirmed. While the DCD provides elevation data for selected safety-related components located in the RCA that are to be protected from flooding, the cited equipment elevations are nominally below the maximum RCA flood levels (see DCD Tier 2 Section 3.4.1.5.2.1). Similarly, cited equipment elevations for safety-related components located in the NRCA that are to be protected from flooding are nominally below the maximum NRCA flood levels (see DCD Tier 2 Section 3.4.1.5.2.2).

As discussed in SRP 3.4.1, Section II, "Acceptance 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. Also, per SRP 3.4.1, Item I.2, the locations of safety-related SSCs relative to the internal flood level should be reviewed, and therefore, should be identified in the DCD.

Demonstrate that safety-related SSCs inside the RCA and NRCA portions of the R/B are located above internal flood levels. Include this information in the DCD and provide a markup in your response.

03.04.01-13

RAI 3.4.1-13

As discussed in DCD Tier 2 Section 3.4.1.5.2.1, floor drains in the east and west areas of the RCA portion of the R/B are isolated by means of a normally closed valve or check valve in individual drainage pathways prior to connecting into a common sump tank system. This design is used to prevent flood waters from the east (or west) from passing into the west (or east) side of the building via the floor drain system. Per DCD Tier 2 Section 3.4.1.5.2.2, a similar arrangement is used within the NRCA portion of the R/B to preclude cross-flow of floor drain water. As discussed in DCD Tier 2 Section 9.3.3.1.1, normally closed manual isolation valves installed in individual drainage pathways of Engineered Safety Feature (ESF) equipment rooms preclude backflow of water into these rooms via the sump system. However, the DCD does not explain how it is ensured that manual valves used to prevent cross-divisional flooding are aligned and maintained in the closed position.

As discussed in SRP 3.4.1, Section II, "Acceptance 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. Also, in accordance with SRP 3.4.1, Item I.4, the staff is to review the adequacy of isolating safety-related systems and equipment in redundant trains.

Where manual isolation valves are relied upon to preclude cross-divisional flooding via the R/B drain and sump systems, demonstrate how it is ensured that these valves are aligned and maintained in the closed position. Include this information in the DCD and provide a markup in your response.

03.04.01-14

RAI 3.4.1-14

The Main Control Room (MCR) and Remote Shutdown Room (RSR) are located in the NRCA portion of the R/B. Per DCD Tier 2 Section 3.4.1.5.2.2, the MCR is isolated from the adjacent R/B corridor by concrete walls and a watertight door. However, the DCD does not discuss whether there are any internal sources of water inside the MCR, and if so, how the MCR is protected from these internal water sources. Furthermore, the DCD does not appear to address flood protection for the RSR.

As discussed in SRP 3.4.1, Section II, "Acceptance 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.

Identify any internal sources of water inside the MCR, and if there are, demonstrate how the MCR is protected from these internal water sources. Also, demonstrate how the RSR is protected from internal flood, in accordance with SRP 3.4.1. Include this information in the DCD and provide a markup in your response.

03.04.01-15

RAI 3.4.1-15

The DCD does not describe how internal flood protection is achieved for SSCs used to provide spent fuel pit cooling.

As discussed in SRP 3.4.1, Section II, “Acceptance 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.

Demonstrate how SSCs used to provide spent fuel pit cooling are protected from internal flood, in accordance with SRP 3.4.1. Include this information in the DCD and provide a markup in your response.

03.04.01-16

RAI 3.4.1-16

The DCD does not describe how internal flood protection is achieved for safety-related SSCs located inside the power source buildings (PS/B). However, as indicated in DCD Tier 2 Table 3.2-2, the PS/B contains some seismic Category I SSCs, including essential service water (ESW) valves, essential chiller pumps, and miscellaneous equipment related to the emergency gas turbines.

As discussed in SRP 3.4.1, Section II, “Acceptance 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.

Demonstrate how safety-related SSCs located in the PS/B are protected from internal flood, including a description of instrumentation for flood detection, in accordance with SRP 3.4.1. Include this information in the DCD and provide a markup in your response.

03.04.01-17

RAI 3.4.1-17

As described in DCD Tier 2 Section 3.4.1, the US-APWR design utilizes watertight doors as an important element of the overall flood protection strategy. However, there is no mention of methods used for assuring the functionality of these watertight doors, for example position indicators, door seals, aging degradation, testing, and maintenance procedure requirements for the door seals.

In accordance with 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.

Describe how the functionality of the watertight doors is assured. Specifically address the means used to determine and assure door position, integrity of door seals, aging degradation, testing, and maintenance procedure requirements for the door seals. Include this information in the DCD and provide a markup in your response.

03.04.01-18

RAI 3.4.1-18

DCD Tier 2, Section 3.4.1.1 states the following: “In general, SSCs are mounted above the flood level. However, if safety-related SSCs are located below flood level, their safety function is assured, as described in Section 3.11.” DCD Tier 2 Table 3D-2, “US-APWR Environmental Qualification Equipment List,” lists components subject to graded environmental conditions. However, this table does not indicate which components, if any, are credited for operation while being submerged. The staff could not determine whether the applicant intends to include the option of submerged SSCs in the DC stage or in the Combined License (COL) application stage.

Per 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.

Clarify whether the US-APWR flood protection design intends to include the option of submerged SSCs operation in the design certification (DC) stage or in the COL application stage. If it is in the DC stage, list the safety-related SSCs that could be located below potential flood levels, and demonstrate how these SSCs will retain their normal function while submerged. If submerged SSCs are to be credited in the COL stage, explain how the DCD will ensure that the COL applicant will address the operability of these SSCs in accordance with SRP 3.4.1. Include this information in the DCD and provide a markup in your response.

03.04.01-19

RAI 3.4.1-19

ITAAC Acceptance Criteria No. 11 in DCD Tier 1, Table 2.2.4, includes the following wording: "…equipment are located at sufficient height the floor surface against the design flood level." This statement is not clear.

10 CFR 52.47(b)(1) requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations. Also, per SRP 3.4.1, Item I.2, the locations of safety-related SSCs relative to the internal flood level should be reviewed, and therefore, should be identified in the DCD.

Clarify the wording associated with the Acceptance Criteria for ITAAC Item No. 11 in DCD Tier 1, Table 2.2-4 so that it explicitly requires equipment to be positioned sufficiently high above the design flood level. Include this information in the DCD and provide a markup in your response

03.04.01-20

RAI 3.4.1-20

As discussed in DCD Tier 2 Section 3.4.1.5.2.1, floor drains in the east and west areas of the RCA portion of the R/B are isolated by means of a normally closed valve or check valve in individual drainage pathways prior to connecting into a common sump tank system. This design is used to prevent flood waters from the east (or west) from passing into the west (or east) side of the building via the floor drain system. Per DCD Tier 2 Section 3.4.1.5.2.2, a similar arrangement is used within the NRCA portion of the R/B to preclude cross-flow of floor drain water. As discussed in DCD Tier 2 Section 9.3.3.1.1, normally closed manual isolation valves installed in individual drainage pathways of Engineered Safety Feature (ESF) equipment rooms preclude backflow of water into these rooms via the sump system. However, the staff could not find an ITAAC entry or DCD Tier 1 discussion that specifically addresses the check valves and manual valves that are used to prevent cross-divisional flooding via floor drain and sump systems.

10 CFR 52.47(b)(1) requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations. Tier 1 Design Descriptions (DD), figures, and ITAAC for fluid systems should include special features used to protect against flood hazards, as indicated in SRP 3.4.1 Appendix C, Items I.A(7), I.B.ix, and II.B.i .

Include, as part of the ITAAC process, check valves and manual valves used to prevent cross-divisional flooding via R/B floor drain and sump systems, consistent with SRP 14.3, Appendix C, Items I.A(7), I.B.ix, and II.B.i. Include this information in the DCD and provide a markup in your response.