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Sent: Tuesday, August 19, 2008 2:45 PM
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Subject: US-APWR Design Certification Application RAI No.51-916
Attachments: US-APWR DC RAI 51 SPCV 916.pdf

MHI,

Attached please find the subject request for additional information (RAI). This RAI was sent to you in draft form. The schedule we established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. Please submit your RAI response to the NRC Document Control Desk.

Thanks,

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REQUEST FOR ADDITIONAL INFORMATION NO. 51-916 REVISION 0

8/19/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 14.03.11 - Containment Systems and Severe Accidents - Inspections, Tests, Analyses, and Acceptance Criteria

Application Section: 14.3.4.11

SPCV Branch

QUESTIONS

14.03.11-1

(14.3.4.11-1)
Clarify the key design features of the CHS system that are to be verified via ITAAC

The Design description for the Containment Hydrogen Monitoring and Control System (CHS) should include more details of the key design features of the hydrogen igniter system and the hydrogen igniters in the system. A figure should be included in the CHS Tier 1 section, noting the location and arrangement of these igniters in the containment.

SRP Chapter 14 appendix C provides guidance for the development of ITAAC used to verify severe accident features.

The Tier 1 design description for the CHS does not provide the specific locations for the hydrogen igniters and the key design features for the igniters. It does not specify a need for a minimum quantity of functional igniters. The operating principle of these igniters is not described. The severe accident function of the igniters is not discussed and the qualification of the igniters to withstand severe accident environment is not stated. No figure is provided in Section 2.11.4 of the Tier 1 US-APWR DCD identifying the locations of the igniters.

Include these descriptions and a figure identifying the locations of the igniters that were assumed in the severe accident analysis as part of Section 2.11.4 of the Tier 1 US-APWR DCD, to include specific ITAAC to verify each key design feature or provide a justification as to why the above information need not be verified via ITAAC. Include a discussion of the roadmaps used to develop the key design features of the CHS system Tier 1 information from the severe accident analysis.

14.03.11-2

(14.3.4.11-2)

Indicate and include ITAAC items that provide verification of critical assumptions from Containment Transient and Accident Analyses.

The NRC staff could not identify what Containment System Tier 1 Section 2.11 ITAAC items provide verification of critical assumptions from Containment Transient and Accident Analyses.

SRP Chapter 14.3 Appendix C provides guidance that states that the critical assumptions from transient and accident analyses should be verified by ITAAC. Cross references ("Roadmaps") should be provided in Tier 2 Section 14.3, showing how the key physical parameters from these Tier 2 analyses are captured in Tier 1.

RG 1.206 Section C.II.1.2.11 provides guidance that key parameters and insights from containment safety analyses, such as LOCA, main steamline break, main feedline break, and subcompartment analysis should be verified by ITAAC.

Section 14.3.4.11 of the DCD states that ITAAC provide for verification of key parameters and insights from containment safety analyses, such as LOCA, main steam line break, main feed line break, and sub compartment analyses. However, there were no cross references or detailed discussion provided in Tier 2 Section 14.3, showing how the key physical parameters from these Tier 2 analyses are captured in Tier 1.

Provide, or indicate where within DCD Tier 2 Chapter 14 the cross references from containment safety analyses that are used to define specific ITAAC are provided. Discuss how the cross references have been used in developing the ITAAC. Also, for each ITAAC item identified, discuss how the ITAAC acceptance criteria will provide verification of the critical assumption from containment safety analyses.

14.03.11-3

(14.3.4.11-3)

Discuss how the ITAAC were developed to verify the existence of severe accident prevention and mitigation features.

Section 14.3.4.11, ITAAC for Containment Systems, of the Tier 2 DCD states that ITAAC provide for verification of the existence of severe accident prevention and mitigation features, but does not provide any additional discussion.

RG 1.206, Section C.II.1.2.11, ITAAC for Containment Systems, states that the applicant should develop ITAAC to verify the existence of severe accident prevention and mitigation design features. Section 14.3.4.11 of the DCD is consistent with RG 1.206 but does provide a discussion or cross-reference of ITAAC items with the severe accident prevention and mitigation features. Section 14.3 of NUREG-0800, Appendix A. IV. 6, states that, at a minimum, the section should include a discussion of the treatment of severe accident design features (item v in the paragraph).

Provide or indicate where within DCD Tier 2 the cross-references or roadmap from severe accident analyses that are used to define specific ITAAC addressing severe accident prevention and mitigation features are provided. Also, for each ITAAC item identified, discuss how the ITAAC acceptance criteria provide verification of the critical assumptions/requirements in severe accident analyses.

14.03.11-4

(14.3.4.11-4)

Explain and specify the severe accident analysis requirements to be satisfied in the Design Commitment and Acceptance Criteria of ITAAC # 4, 5, 6, and 7 in Table 2.11.1-2, Containment Vessel ITAAC.

The design commitment and acceptance criteria in the above mentioned ITAAC are written in terms of meeting severe accident analysis requirements. For example, the acceptance criteria of ITAAC #4 in Table 2.11.1-2 state that "the as-built drain piping to the reactor cavity exists that meets severe accident analysis requirements." Since it does not refer to or specify the severe accident analysis requirements to be met, these ITAAC are not clear. Severe accident analysis requirements should be specified.

14.03.11-5

(14.3.4.11-5)

Indicate ITAAC items that provide an analysis or demonstration to show that safety related containment system instrumentation has been qualified for a harsh environment.

The NRC staff could not identify ITAAC that provide verification of the environmental qualification of safety related instrumentation in the Containment Isolation System.

SRP Chapter 14.3 Appendix C provides guidance that states that the system ITAAC should include analysis of demonstration to show that the safety system equipment has been qualified by type test, previous operating experience, or analysis or any combination of these three methods to substantiate that it should be capable of meeting, on a continuing basis, the design-basis performance requirements.

ITAAC item #6.a in Table 2.11.2-1 provides for verification of harsh environment qualification for those items listed in table 2.11.2-1. The NRC staff noted that the instrumentation associated with the Containment Isolation System, and shown on Figure 2.11.2-1, are not listed in Table 2.11.2-1.

Provide (or indicate where in Tier 1 of the DCD it is provided) ITAAC that verify the environmental qualification of safety related instrumentation in the Containment Isolation System.

14.03.11-6

(14.3.4.11-6)
Revise applicable system ITAAC and associated tables to assure verification of the containment isolation functions of different systems.

Table 2.11.2-1, Containment Isolation System Equipment Characteristics, of Section 2.11.2 provides a listing of many isolation valves and their characteristics. Many other isolation valves and the corresponding ITAAC are addressed in the respective systems. These systems/components are noted with dotted lines in Figure 2.11.2-1. For example, the isolation valves in RHRS, SIS, FWS, MSS are addressed in the respective system description and ITAAC. In some systems (e.g., CVCS, CCWS, PSS, and SGBDS), a check of the system equipment table reveals that some of the isolation valves have not

been addressed. For example, CVCS seal water return line check valve CVCS-VLV-202 is not included in Table 2.4.6-2 and therefore not addressed by the ITAAC, RCP CCW supply line inside containment isolation valves VLV-403A and B are not listed in CCWS Table 2.7.3.3-2 and are not addressed by ITAAC. Also, for some systems, a check of the system ITAAC table reveals that an ITAAC item addressing the containment isolation function of the valves is not included. For example, SGBDS valves SGS-AOV-031A and others are listed in CCWS ITAAC Table 2.7.1.10-1, but there is no containment isolation function ITAAC for these valves in Table 2.7.1.10-3. Similarly, CCWS Valves 402A and B and 445 A and B are listed in CCWS Table 2.7.3.3-2, but there is no Containment Isolation Function ITAAC for those valves in Table 2.7.3.3-3.

Revise the associated Tables to assure verification of containment isolation function of different systems. Provide a list of the revisions made or a list of ITAAC addressing containment isolation functions of valves.

14.03.11-7

(14.3.4.11-7)
Provide verification through ITAAC that the location of the outermost isolation valve is such that the length of the pipe from containment to the valve is not greater than the specified value.

Containment isolation valves are designed to be located within certain distance from the containment. Table 6.2.4-3, List of Containment Penetrations and System Isolation Provisions, (Column 10), in Tier 2 provides the length of the pipe and the CIV distances should not be greater than the value defined. This is a key design feature and should be included in Tier 1 design description. An ITAAC verifying that the valve positions do not violate this maximum distance is considered applicable.

14.03.11-8

(14.3.4.11-8)

Indicate ITAAC items that provide verification of the minimum inventory of alarms, displays and controls for the CHS and CIS systems.

The NRC staff could not identify ITAAC that provide verification of generation of minimum inventory of alarms, displays and controls for the CHS, some instrumentation on the CIS system, and containment isolation function of some systems.

The US-APWR DCD Section 14.3.4.11 ITAAC for Containment Systems states that ITAAC provide for verification of the minimum inventory of alarms, displays, and controls.

In accordance with SRP chapter 14.3 Appendix C, the design description of the containment vessel, containment spray system, containment isolation system, and containment hydrogen monitoring system in Section 2.11 of the Tier 1 DCD identifies the alarms, displays, and controls in the MCR. ITAAC to verify that these alarms, controls, and displays can be retrieved in the MCR are defined for the containment spray system and the containment isolation system.

Discuss if any ITAAC is required to verify that alarms, displays, and controls can be retrieved for the containment vessel.

For the Containment Isolation System, provide (or indicate where in Tier 1 it is provided) ITAAC required to verify the minimum inventory of alarms, displays and controls associated with the containment instrumentation shown on Figure 2.11.2-1, that is not listed in Table 2.11.2-1. Amend Table 2.11.2-1 as required.

For systems with containment isolation functions (e.g., CVCS, SGBDS, PSS), provide ITAAC to verify the display of position indication of the containment isolation valves in the MCR. Include the displays of the CIV positions in the respective system table (e.g., Table 2.4.6-4 for CVCS) for their verification by the ITAAC (e.g., ITAAC item #12 in Table 2.4.6-5). For example, CVCS letdown isolation valves CVCS-AOV-005 and 006 position indication are not listed in Table 2.4.6-4.

Provide (or indicate where in Tier 1 it is provided) ITAAC required to verify the minimum inventory of alarms, displays and controls are provided for the CHS system, as described in the design description paragraph 2.11.4.1.

14.03.11-9

(14.3.4.11-9)
Define ITAAC to verify the automatic activation of the hydrogen igniters when required.

RG 1.206, Appendix C.II.1-A, General ITAAC Development Guidance, II.G. Initiation Logic, states that if a system/component has a direct safety function, it typically receives automatic signals to perform some action (e.g., start, isolation). The system ITAAC should capture these aspects related to system's direct safety function. The hydrogen igniters are activated automatically in response to an ECCS actuation signal and are considered to have a safety function even though the CHS is a non safety-related system. Because of this safety function of the igniters, ITAAC should be developed to verify automatic activation/alignment of the igniters.

Define an ITAAC for automatic activation of the hydrogen igniters.

14.03.11-10

(14.3.4.11-10)
Clarify the seismic design feature of the CHS that are to be verified via ITAAC

RG 1.206, Appendix C.II.1-A, General ITAAC Development Guidance, Special Cases for Seismic Qualification, states that some nonsafety equipment may require special treatment because of its importance to safety. Hydrogen igniters can be considered a special case for seismic qualification because of the role they play in severe accident conditions and their location near safety related equipment.

Please discuss the assumptions used as to the equipment survivability expectations of the CHS components in the event of credible seismic severe accident initiating event, such that they perform their severe accident function. Also include a discussion on the assumed effects the igniter components would have on nearby safety related equipment in the event of a design basis seismic event.

Justify why the assumed hydrogen igniter design features need not be verified via ITAAC.
If necessary, define applicable ITAAC to address the verification of the design features for these assumptions.

14.03.11-11

(14.3.4.11-11)
Define the ITAAC to verify embedment depth.

The US-APWR DCD Table 2.11.1-2 Containment Vessel Inspection, Tests, Analyses, and Acceptance Criteria does not contain any ITAAC item related to the verification of the embedment depth.

RG 1.206, Section C.II.1 Inspections, Tests, Analyses, and Acceptance Criteria, Appendix A, Building Structures, provides guidance and the related rationale for what an applicant should include in the ITAAC for building structures. It states that the building description should specify – and the ITAAC should verify – the embedment depth (from the top of the foundation to the finished grade). Discuss why verification of the embedment depth is not identified as an ITAAC item in Table 2.11.1-2 or indicate where the item is addressed within the supplied ITAAC

14.03.11-12

(14.3.11-12)
Clarify Acceptance Criteria for Containment Vessel ITACC item #3 in Table 2.11.1-2

Table 2.11.1-2 of the US-APWR DCD item #3 defines acceptance criteria for ITAAC for the PCCV structural configuration as shown in Figure 2.11.1-1. However, Table 2.2-2, 'Definition of wall thicknesses for safety related structures: PCCV, Containment internal structure, Reactor Building, and Power Source Building', defines the wall thicknesses.

RG 1.206, Section C.II.1 Inspections, Tests, Analyses, and Acceptance Criteria, Appendix A for Building Structures provides guidance that states that building structure design description should provide sufficient dimensions for the COL applicant or licensee to verify by ITAAC and develop dynamic models for the seismic analysis. Examples of these dimensions include overall building dimensions as well as thicknesses of walls, floor slabs, and foundation mat.

The ITAAC defined for the inspections of the as built PCCV should also refer to Table 2.2-2, which contains additional relevant parameters for verification.

14.03.11-13

(14.3.4.11-13)
Indicate ITAAC items that provide verification of overcurrent protection of electrical penetrations.

For containment electrical penetration, RG 1.206 section C.II.1.2.6 provides guidance that states that the applicant should develop ITAAC to verify that all electrical penetrations are protected against postulated currents greater than their continuous

current rating. Such an ITAAC was not noted in the ITAAC presented for the containment systems.

Justify why such an ITAAC item is not required or define applicable ITAAC for the containment electrical penetrations.

14.03.11-14

(14.3.4.11-14)
Provide ITAAC to verify containment isolation valve position on loss of motive power for selected systems.

The design description of the containment isolation system and the containment spray system identifies the loss of motive power position for the remotely operated valves. A table is provided (Table 2.11.2-1 for Containment Isolation System and Table 2.11.3-2 for Containment Spray System) identifying the loss of motive power position for the remotely operated valves. Containment spray system has identified an ITAAC for verifying that each as-built remotely operated valve assumes the indicated loss of motive power position (item #9.b). However, a similar ITAAC was not defined for the containment isolation system.

Justify the lack of a similar ITAAC for the containment isolation system or provide applicable ITAAC for the system.

14.03.11-15

(14.3.4.11-15)
Clarify ITAAC to verify containment isolation valve electrical redundancy.

In the US-APWR Tier 1 Containment Isolation system design description paragraph 2.11.2.1, the containment isolation system key design features state that where actuation of two power-operated isolation valves on the same penetration (in series) is required, electrical redundancy is provided by independent power sources. The NRC staff noted that there are no ITAAC defined to verify the electrical independence of the containment isolation valves.
SRP 14.3 Appendix C provides guidance for the development of ITAAC to verify independence. The ITAAC should include analysis or demonstration to show that there is physical, electrical and communications independence between redundant portions of a safety system.

Justify the lack of ITAAC to verify this key design feature of the CIS or provide appropriate ITAAC in the CIS sections or other system sections.

14.03.11-16

(14.3.4.11-16)
Indicate ITAAC items and include additional ITAAC items, as necessary that address PRA and severe accident insights.

RG 1.206 and SRP Section 14.3 state that PRA and severe accident insights should be addressed in ITAAC. RG 1.206 states that if the PRA results indicate that a particular system component or function is risk-significant, ITAAC should verify that component or function. It further states that Section 14.3 of the application should include roadmaps for PRA, including shutdown safety analyses and severe accidents with specific references to the system ITAAC where the key parameters from those analyses are verified. Chapter 19 of the application should identify PRA insights.

Section 19.1.3.2 of the Tier 2 DCD discusses the design/operational features for mitigating the consequences of core damage and preventing releases from containment and Section 19.1.3.3 discusses the design/operational features for mitigating the consequences of releases from containment. The design/operational features addressed in these sections include RCS depressurization through severe accident depressurization valves, alternative containment cooling, fire water injection into the reactor cavity and to the spray header. No ITAAC items were noted addressing these design/operational features.

Present an analysis (e.g., a roadmap) of the PRA and severe accident results/insights with specific reference to the system ITAAC where the key parameters from those analyses are verified. Identify existing ITAAC or develop additional ITAAC to assure that PRA and severe accident insights are addressed..

14.03.11-17

14.3.4.11-17
Revise the DCD or address the editorial comments.

In Table 2.11.2-2, CIS ITAAC, item 6b is same as item12. It appears that one is a repeat of the other. Make the necessary correction.

In Table 2.11.3-5, pg. 2.11-29, item 9b, replace "Table 2.9.3-2" by "Table 2.11.3-2" both in Design Commitment and Acceptance Criteria column.

In Table 2.11.3-5, pg. 2.11-27, item 5b, Acceptance Criteria, replace "Table 2.3.11-3" by "Table 2.11.3-3."