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TOKYO, JAPAN

December 12, 2008

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-08283

Subject: MHI's Responses to US-APWR DCD RAI No. 101-1474 Revision 1

Reference: 1) "Request for Additional Information No. 101-1474 Revision 1, SRP Section: 17.04 - Reliability Assurance Program (RAP)," dated November 12, 2008

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document as listed in Enclosure.

Enclosed is the responses to the RAIs contained within Reference 1.

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

Sincerely,



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

Enclosure:

1. "Responses to Request for Additional Information No. 101-1474 Revision 1"

CC: J. A. Ciocco
C. K. Paulson

Contact Information

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Docket No. 52-021
MHI Ref: UAP-HF-08283

Enclosure 1

UAP-HF-08283
Docket No. 52-021

Responses to Request for Additional Information
No. 101-1474 Revision 1

December 2008

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17-04-1

Section 17.4.7.1 of the US-APWR DCD, Revision 1 describes the methodology for identifying risk significant SSCs and references Section 19.1.7.4 of the US-APWR DCD, Revision 1, which states "Risk significant SSCs are identified for the RAP (Chapter 17, Section 17.4). Key risk significant SSCs are organized by a FV importance greater than 0.005 and RAW greater than 2 in accordance with Reference 19.1-42. These thresholds are consistent with Reference 19.1-43." The stated Reference 19.1-43 refers to "10 CFR 50.69 SSC Categorization Guideline" (NEI 00-04, Revision 0), which uses, in addition to the criteria stated above, a common cause basic event RAW criteria of greater than 20 for identifying risk significant SSCs. It is not clear from Sections 17.4.7.1 and 19.1.7.4 of the US-APWR DCD, Revision 1, as to what RAW criteria (e.g., 2, 20, or some other value) was used for common cause basic events by the applicant during risk significant SSC identification. The staff requests that the applicant clarify in the US-APWR DCD the RAW criteria used for common cause basic events in developing the list of risk significant SSCs.

ANSWER:

In accordance with NUMARC93-01 (Reference 19.1-42 of Section 19.1.7.4 of the US-APWR DCD, Revision 1) , risk significant SSCs are identified by a FV importance greater than 0.005 and RAW greater than 2. In the US-APWR RAP, these criteria have been applied to both single failure basic events and common cause failure (CCF) basic events.

Risk significant SSCs identified by RAW greater than 2 cover sufficiently those identified by RAW greater than 20, which is the RAW criterion for CCF basic events used in NEI-00-04. Moreover, the difference in the resulting lists of risk important SSCs captured by the two different RAW criteria for CCF events is small.

The RAW criteria used for CCF basic events in developing the list of risk significant SSCs will be clarified in the next revision of the US-APWR DCD.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 in the response to RAI 17.04-1 as noted above.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI..

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17 04 - Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-2

Section 17.4.7.1 of the US-APWR DCD, Revision 1 describes the methodology for identifying risk significant SSCs and references Section 19.1.7.4 of the US-APWR DCD, Revision 1, which states "Risk significant SSCs are identified for the RAP (Chapter 17, Section 17.4). Key risk significant SSCs are organized by a FV importance greater than 0.005 and RAW greater than 2 in accordance with Reference 19.1-42. These thresholds are consistent with Reference 19.1-43. In addition, risk significant information based on LPSD PRA and external PRA, SSCs related Initiating events, and key assumptions are identified." The applicant computed RAWs/FVs for various risk hazards (e.g., internal events/internal fire/internal flood at power and shutdown). It is not clear from Sections 17.4.7.1 and 19.1.7.4 of the US-APWR DCD, Revision 1, as to how the risk importance criteria (i.e., FV importance greater than 0.005 and RAW greater than 2) were applied to the various risk hazard models that computed RAWs and FVs (i.e., were the RAW/FV criteria applied only to the internal events model, or applied to each risk hazard model separately, or applied to the combined/integrated results of the risk hazard models). Based on the stated Reference 19.1-43 ("10 CFR 50.69 SSC Categorization Guideline," NEI 00-04, Revision 0) each risk hazard should be:

- a) Evaluated separately to avoid reliance on a combined result that may mask the results of individual risk contributors, and
- b) Combined in an integrated importance assessment to understand risk significance from an overall perspective (see Section 5.6 of Reference 19.1-43).

The staff requests that the applicant clarify in the US-APWR DCD how the risk importance criteria (i.e., FV importance greater than 0.005 and RAW greater than 2) were applied to the various risk hazard models that computed RAWs and FVs (e.g., were each risk hazard model evaluated separately, or risk hazard models combined in an integrated importance assessment).

ANSWER:

RAW/FV criteria were applied to each risk hazard model separately. For each risk hazards, risk significant SSCs were identified based on the risk importance criteria (i.e., FV importance greater than 0.005 and RAW greater than 2). The list of risk significant SSCs for each risk hazards were then combined into a single list. Thus the final list of risk significant SSCs provided by the PRA captures the results of all risk hazards. This list contains risk significant SSCs that would be identified from the integrated importance assessment.

In the next revision of the US-APWR DCD, the document will be revised to clarify how the risk importance criteria were applied to the various risk hazard models to compute RAWs and FVs.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 in the response to RAI 17.04-2 as noted above.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17 04 - Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17-04-3

Risk Achievement Worth (RAW) and Fussell Vesely (FV) were not determined for various probabilistic risk assessment (PRA) models described in Chapter 19 of the USAPWR DCD, Revision 1. These PRA models include: internal events (Level 1, 2) at lowpower and shutdown (LPSD) for various plant operational states (POS), internal fire (Level 2) at power, internal fire (Level 1) at LPSD, internal flood (Level 2) at power, internal flood (Level 1) at LPSD. Since the RAWs/FVs were not determined for these models, it is not clear from Sections 17.4.7.1 and 19.1.7.4 of the US-APWR DCD, Revision 1, how these models were used to identify risk significant SSCs. The staff requests that the applicant describe in the US-APWR DCD the process used for identifying risk significant SSCs from PRA models for which RAWs/FVs were not computed. If these PRA models were not used in identification of risk significant SSCs, then incorporate the use of these PRA models for identifying risk significant SSCs; otherwise, provide the basis for not considering these PRA models for identifying risk significant SSCs.

ANSWER:

For LPSD, the importance analysis was applied to the representative plant operation state (POS) PRA has been performed. The representative POS that PRA has been performed is POS 8-1, mid-loop operation. For other POSs, PRA was not performed and FV/RAW values have not been computed.

For POSs other than POS 8-1, SSCs that are not credited as mitigation function in POS 8-1 but are credited in the POS were all identified as risk significant SSCs.

For severe accident management SSCs, SSCs required to satisfy the requirements of 10CFR were identified as risk significant SSCs (e.g. igniter). SSCs that are not modeled in the PRA but the loss of whose functions may directly result in large release, were identified as risk significant SSCs (e.g. containment vessel).

In the next revision of the US-APWR DCD, the process used for identifying risk significant SSCs from PRA models for which RAWs/FVs were not computed will be documented.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted above in the response to RAI 17.04-3

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17-04-4

From Chapter 19 of the US-APWR DCD, Revision 1, the evaluation of seismic external events is based on a seismic margin analysis (SMA). According to SECY 93-087, this method identifies potential design-specific seismic vulnerabilities that may be useful in developing the RAP. Sections 17.4.7.1 and 19.1.7.4 of the US-APWR DCD, Revision 1, do not describe how the SMA was used to identify risk significant SSCs. Furthermore, the absence of SMA in the rationale that is provided in Table 17.4-1 of the US-APWR DCD, Revision 1, suggests that SMA was not considered in identifying risk significant SSCs. SSCs under SMA are credited as part of the safe shutdown paths evaluated under the SMA. In addition to being capable of withstanding seismic events, these SSCs need to have high reliability and availability in order to perform their safe shutdown functions. Therefore, these SSCs should be in scope of D-RAP. The SMA is another tool used to identify risk-significant SSCs for D-RAP in accordance with SECY 95-132. The reliability of SSCs that are outside the PRA study (e.g., structures) could be monitored qualitatively through operational programs. The staff requests that the applicant include in D-RAP the SSCs identified as risk significant under SMA ("10 CFR 50.69 SSC Categorization Guideline," NEI 00-04, Revision 0, provides an acceptable approach), or justify why they should not be included. The US-APWR DCD should be updated accordingly.

ANSWER:

In US-APWR DCD, Revision 1, SMA was not used to identify risk significant SSCs

MHI will identify risk significant SSCs based on the results of SMA, according to the approach provided by NEI 00-04, Revision 0. The identified SSCs will be discussed in the expert panel for D-Rap.

In the next revision of the US-APWR DCD, list of risk significant SSCs will be updated incorporating the

results of SMA and expert panel.

Impact on DCD

List of risk significant SSCs in US-APWR DCD, Revision 2, will be updated considering the result of SMA and expert panel.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17-04-5

Section 17.4.7.1 of the US-APWR DCD, Revision 1 describes the methodology for identifying risk significant SSCs and references Section 19.1.7.4 of the US-APWR DCD, Revision 1, which states "Risk significant SSCs are identified for the RAP (Chapter 17, Section 17.4). Key risk significant SSCs are organized by a FV importance greater than 0.005 and RAW greater than 2 in accordance with Reference 19.1-42. These thresholds are consistent with Reference 19.1-43." FV importance can be computed at a basic event (failure mode, e.g., fail to start, fail to run) level and at a component level (i.e., sum of FVs for all basic events, or failure modes, modeling the component of interest, including common cause events). Based on the stated References 19.1-42 (NUMARC 93-01, Revision 3) and 19.1-43 (NEI 00-04, Revision 0) the component FV importance should be applied to the FV criteria of 0.005. However, Sections 17.4.7.1 and 19.1.7.4 and Table 17.4-1 of the US-APWR DCD, Revision 1, suggest that basic event FV importance was applied to the FV criteria of 0.005, which may not be appropriate. The staff requests that the applicant clarify in the US-APWR DCD the use of FV importance in identifying risk significant SSCs (i.e., were basic event FVs or component FVs applied to the FV criteria of 0.005). If basic event FVs were applied to the FV criteria, then incorporate the use of component FVs ("10 CFR 50.69 SSC Categorization Guideline," NEI 00-04, Revision 0, provides an acceptable approach); otherwise provide the basis for applying basic event FVs (as opposed to component FVs) to the FV criteria.

ANSWER:

In the US-APWR DCD, Revision 1, FV importance was computed at a basic event level. The FV importance criterion 0.005 was applied to the basic event level FVs. SSCs that had a failure mode with FV higher than the criterion were identified as the risk important SSCs. The FV criterion was not applied to the component level FVs.

MHI will compute the FVs importance at a component level and revise the list of risk significant SSCs base on the component level FVs. In the next revision of the US-APWR DCD, list of risk significant SSCs will be updated base on the results of component level FVs and the expert panel.

Impact on DCD

List of risk significant SSCs in US-APWR DCD, Revision 2, will be updated considering the result of FVs computed at components level and the expert panel.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-6

Based on Sections 17.4.7.1 and 19.1.7.4 of the US-APWR DCD, Revision 1, it is not clear whether the expert panel reviewed the categorization of SSCs determined to be not risk-significant (NRS) from quantified PRA results. The expert panel plays an important role in reviewing the information that lead to these NRS determinations (e.g., assure the basis used in the categorization is technically adequate, review defense-in-depth implications, review safety margin implications, for additional information see Sections 9.2.2 and 9.2.3 of technical guidance report NEI 00-04, Revision 0). This is particularly important for those safety-related SSCs determined to be NRS from these processes.

The staff requests that the applicant incorporate into their risk significance methodology the use of an expert panel to review the categorization of SSCs that were determined to be not risk-significant from quantified PRA results. The US-APWR DCD, Revision 1, should be revised, accordingly, to describe the role that the expert panel has in reviewing these NRS determinations (e.g., assure the basis used in the categorization is technically adequate, review defense-in-depth implications, review safety margin implications).

Answer:

In the US-APWR DCD, Revision 1, the categorization of SSCs determined to be not-risk-significant (NRS) from quantified PRA results was not reviewed explicitly by the expert panel. In the US-APWR DCD, Revision 2, the following sentence will be inserted before the last sentence of Section 17.4.7.1, and the categorization of SSCs determined to be NRS will be reviewed explicitly by the expert panel to be reflected in the US-APWR DCD, Revision 2:

"The EP also reviews the categorization of SSCs determined to be not risk significant from quantified

PRA results (e.g., technical adequacy of the basis used in the categorization, review of defense-in-depth implications, review of safety margin implications)."

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted in the response to RAI 17.04-6.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-7

Section 17.4.7.2 of the US-APWR DCD, Revision 1, states " An EP, consisting of at least one person with design engineering experience, at least one person with PRA experience, at least one person with operations and maintenance experience, and at least one person with quality assurance experience, is responsible for the final selection of the SSCs included in the D RAP. Industry operating experience when it can be applied to assessing risk significance, and engineering judgment are employed in considering the addition of SSCs to the D-RAP. Each voting member of the RAP EP should have the level of education and experience defined by the RAP implementing procedure." PWR operations and maintenance experience is an important expert panel (EP) attribute, which is not discussed in the above statement, though it is suggested in Section 17.4.7.1 of the US-APWR DCD, Revision 1.

The staff requests that the applicant clarify the EP experience in Section 17.4.7.2 of the US-APWR DCD by including experience in operations and maintenance; otherwise provide a justification for not including operations and maintenance experience on the EP.

ANSWER:

The first sentence of Section 17.4.7.2 of the US-APWR DCD, Revision 1 will be changed to "An EP, consisting of at least one person with design engineering experience, at least one person with PRA experience, at least one person with operations and maintenance experience, and at least one person with quality assurance experience, is responsible for the final selection of the SSCs included in the D RAP." in the US-APWR DCD, Revision 2.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted in the response to RAI 17.04-7.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-8

Section 17.4.2 of the US-APWR DCD, Revision 1, states "The results of each of these activities are provided to an expert panel (EP) which identifies risk significant items using probabilistic, deterministic, and other methods for inclusion in the program." Section 17.4.3 states "The risk-significant SSCs are identified using PRA, deterministic, or other methods of analysis, including industry experience, and expert panels." It is unclear as to what "deterministic and other methods" were used by the EP in the risk significant SSC determination process.

The staff requests that the applicant clarify in Section 17.4 of the US-APWR DCD the "deterministic and other methods" that were used by the EP in the risk significant SSC determination process.

ANSWER:

In the risk-significant SSC determination process, industry experience and use of the Expert Panel were used as the part of deterministic approach and other processes. Containment fan cooler and Main control room air handling unit are the example of items added by the EP. To clarify this approach, the second sentence of Section 17.4.7.2 of the US-APWR, Revision 1 will be changed to "Industry operating experience and use of the Expert Panel are used as the part of deterministic approach and other processes, and engineering judgment are employed in considering the addition of SSCs to the D-RAP." in the US-APWR DCD Rev.2.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted in the response to RAI 17.04-8.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17 04 - Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-9

SECY 95-132, Item E, states "An application for advanced reactor design certification or a combined license must contain: (1)... and (4) for those structures, systems, and components designated as risk significant: (i) a process to determine dominant failure modes that considered industry experience, analytical models, and applicable requirements: and (ii)..." Section 17.4 of the US-APWR DCD, Revision 1, does not describe a process to determine dominant failure modes for risk significant SSCs as required by SECY 95-132. The staff requests that the applicant describe in Section 17.4 of the US-APWR DCD the process to determine dominant failure modes for risk significant SSCs that considers industry experience, analytical models, and applicable requirements (e.g., consideration of operating experience, PRA importance analyses, root cause analyses, failure modes and effects analyses, equipment performance information, including vendor manuals, and technical specifications). Also, describe who is responsible (e.g., DC applicant, COL applicant, or COL license holder) for determining the dominant failure modes of risk significant SSCs and include this as a COL action item, if necessary, in Section 17.4.9, "Combined License Information" of the US-APWR DCD.

ANSWER:

The PRA models failure modes of SSCs that potentially impact the reliability of mitigation functions as basic events. The results of the importance analysis provide information on dominant failure modes of each SSCs modeled. In the next revision of the US-APWR DCD, the process to determine dominant failure modes will be described

In the PRA, failure modes of SSCs were extracted from available generic data sources of failure rates and probabilities such as NUREG/CR-6928, IEEE std-500, NUREG/CR-4550 and others. Failure modes applicable to the SSCs credited in the US-APWR PRA were selected from the list of failure modes reported in the generic data sources. These failure modes were modeled in the fault trees as basic

events in the PRA. Failure rates and failure probabilities of each failure modes that were considered to be most applicable to the US-APWR were also chosen from the generic data sources. Dominant failure modes determined by the results of importance analysis inputted to the RAP. The process to determine dominant failure modes will be documented in section 17.4 during the next revision of the US-APWR DCD.

MHI has developed the PRA model and performed importance analysis during the DC application. Therefore MHI is responsible for determining the dominant failure modes of risk significant SSCs.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 in the response to RAI 17.04-9 as noted above.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-10

COL Information Item 17.4(2) in Section 17.4.9 of the US-APWR DCD, Revision 1, states "The COL Applicant shall be responsible for the development and implementation of the O-RAP, in which the RAP activities should be integrated into the existing operational program (i.e., Maintenance Rule, surveillance testing, in-service inspection, in-service testing, and QA). The O-RAP should also include the process for providing corrective actions for design and operational errors that degrade non-safety-related SSCs within the scope of the RAP." In accordance with SECY-95-132, Item E, and Standard Review Plan, Chapter 17.4 (NUREG-0800), integrating RAP activities into existing operational programs should also address:

- a) Establishing reliability performance goals for SSCs within the scope of the RAP (for example, implementation of the maintenance rule following the guidance contained in Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," is one acceptable method for establishing performance goals provided that SSCs are categorized as high-safety-significant within the scope of the Maintenance Rule program).
- b) Establishing performance and condition monitoring requirements to provide reasonable assurance that risk significant SSCs do not degrade to an unacceptable level during plant operations (the reliability performance monitoring does not need to statistically verify the numerical values used in the PRA; however, it would provide a feedback mechanism for periodically evaluating reliability assumptions on the basis of actual equipment, train, or system performance and other operational experience).

The staff requests that the applicant address the above comments (in particular, those SSCs within the scope of the RAP should be categorized as high-safety-significant within the scope of Maintenance Rule) in COL Information Item 17.4(2) in Section 17.4.9 of the US-APWR DCD.

ANSWER:

After the last paragraph of COL Information Item 17.4(2) in Section 17.4.9 of the US-APWR DCD, Revision 1, the following paragraphs will be inserted in the US-APWR DCD, Revision 2.

All SSCs identified as risk-significant within the scope of the D-RAP should be categorized as high-safety-significant (HSS) within the scope of initial Maintenance Rule.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted in the response to RAI 17.04-10.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-11

COL Information Item 17.4(1) in Section 17.4.9 of the US-APWR DCD, Revision 1, states "The COL Applicant shall be responsible for the development and implementation of the Phases II and III of the D-RAP. In the Phase II, the plant's site-specific information should be introduced to the D-RAP process and the site-specific SSCs should be combined with the US-APWR design SSCs into a list for the specific plant. ..."

Referring to the above quoted statement, the use of "site-specific risk significant SSCs" appears to be more appropriate than "site-specific SSCs", and the use of "design risk significant SSCs" appears to be more appropriate than "design SSCs". The staff requests that the applicant make these appropriate changes in COL Information Item 17.4(1) in Section 17.4.9 of the US-APWR DCD; otherwise provide a justification for not making these changes.

ANSWER:

The use of "site-specific SSCs" and "the US-APWR design SSCs" of COL Information Item 17.4(1) in Section 17.4.9 of the US-APWR DCD, Revision 1 will be changed to "site-specific risk-significant SSCs" and "the US-APWR design risk-significant SSCs", respectively in the US-APWR DCD, Revision 2.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted in the response to RAI 17.04-11.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

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Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-12

Section 17.4.2 of the US-APWR DCD, Revision 1, states "The purposes of the USAPWR RAP are to provide reasonable assurance that: 1) the US-APWR is designed, constructed, and operated in a manner that is consistent with the assumptions and risk insights for the SSCs, 2) the SSCs do not degrade to an unacceptable level during plant operations..."

Referring to the above quoted statement, the use of "risk significant SSCs" appears to be more appropriate than "SSCs". The staff requests that the applicant make these appropriate changes in Section 17.4.2 of the US-APWR DCD; otherwise provide a justification for not making these changes.

ANSWER:

The use of "SSCs" of Section 17.4.2 of the US-APWR DCD, Revision 1 will be changed to "risk-significant SSCs" in the US-APWR DCD, Revision 2.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted in the response to RAI 17.04-12.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-13

Section 2.13.1 of the US-APWR DCD, Tier 1, Revision 1, states "The purposes of the US-APWR design reliability assurance program (D-RAP) are to provide reasonable assurance that: The US-APWR is designed, constructed, and operated in a manner that is consistent with the assumptions and risk insights for the structure, system, and components (SSCs). ..."

Referring to the above quoted statement, the use of "risk significant structure, system, and components (SSCs)" appears to be more appropriate than "structure, system, and components (SSCs)". The staff requests that the applicant make this appropriate change in Section 2.13.1 of the US-APWR DCD, Tier 1; otherwise provide a justification for not making this change.

ANSWER:

The sentence of the first bullet of Section 2.13.1 of the US-APWR DCD, Tier 1, Revision 1, will be changed to "The US-APWR is designed, constructed, and operated in a manner that is consistent with the assumptions and risk insights for the risk-significant structure, system, and components (SSCs)." in the US-APWR DCD, Tier 1, Revision 2..

Impact on DCD

DCD Tier 1, Section 2.13 will be revised in Revision 2 as noted in the response to RAI 17.04-13.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-14

Section 17.4.4 (c) (Procedures and Instructions) of the US-APWR DCD, Revision 1, states "General Manager, US-APWR project or his designated representative has prepared the procedures and instructions used in implementation of the D-RAP." Section 17.4.7.2 (Expert Panel) states "Each voting member of the RAP EP should have the level of education and experience defined by the RAP implementing procedure." These procedures and instructions are not provided in the US-APWR DCD; therefore, it is not clear what is meant by "level of education and experience defined by the RAP implementing procedure."

The staff requests that the applicant describe in Section 17.4.7.2 of the US-APWR DCD the level of education and experience defined by the RAP implementing procedure.

ANSWER:

In the US-APWR DCD, Revision 2, the last sentence of Section 17.4.7.2 of the US-APWR DCD, Revision 1 will be modified and the description of the level of education and experience defined by the expert panel implementing procedure will be added as follows:

The level of education and experience of voting member of the RAP EP is defined in the Expert Panel Implementing Procedure for US-APWR Reliability Assurance Program as follows:

- a) A person with a science or technical degree and 10 years of experience in the specific area of Nuclear Power Plant, such as design, or similar experience.

or

- b) A person with a non-technical degree and 15 years of experience in the specific area of Nuclear Power Plant, such as design, or similar experience.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 as noted in the response to RAI 17.04-14.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17 04 - Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-15

The applicant did not include in Table 17.4-1 of the US-APWR DCD, Revision 1, motor driven/diesel driven fire suppression pumps. The evidence presented below suggests these pumps are risk-significant and should be included in D-RAP:

- a) Important insights from Table 17.4-1 of the US-APWR DCD, Revision 1, include:
- Given a core damage accident, the fire suppression system (FSS) injects water from Raw Water Tank into the reactor cavity via the direct injection line by the fire water pumps.
 - Given a loss of component cooling water event, fire suppression system or nonessential chilled water system provides alternative component cooling water to charging pumps in order maintain RCP seal water injection.
- b) Table 19.1-106 (Important SSCs of each System in POS 8-1) states that the motor driven/diesel driven fire suppression pumps are important SSCs.

The staff requests that the applicant include in Table 17.4-1 of the US-APWR DCD, Revision 1, the motor driven/diesel driven fire suppression pumps. Otherwise, provide the basis for not including these pumps in Table 17.4-1 of the US-APWR DCD. Please include, in your discussion, the associated risk importance measures (e.g., RAWs and FVs), consideration of deterministic methods (e.g., defense-in-depth), and the expert panel's deliberation for not including these pumps in D-RAP.

ANSWER:

The risk importance of the fire water service pump for internal events is summarized in Table 17.04-15-1.

Table 17.04-15-1 Importance of fire water service pumps

Component		Failure mode with maximum FV value	RAW	FV
Motor driven fire water service pump	Level 1 internal events (CDF)	Fail to start	1.5	6.8E-4
	Level 2 internal events (LRF)	Fail to start	1.7	1.0E-3
Diesel driven fire water service pump	Level 1 internal events (CDF)	Fail to start	1.0	1.5E-4
	Level 2 internal events (LRF)	Fail to start	1.2	5.8E-4

The fire water service pumps also showed small risk importance value for external events and were identified as non-risk significant SSCs. This is because the fire service water service pumps are diversity in types (motor driven and diesel driven) and therefore common cause failure are unlikely to occur. The risk importance values of the fire water service pumps were also small for low power and shutdown PRA. The FV and RAW values were below the criteria used to identify risk important SSCs.

In addition, it appears that in some instances from industry information that the fire protection system provides an added benefit in the response to large fires and explosions which are remote and are well beyond the design basis. Therefore MHI will forward this consideration to the expert panel for consideration.

And as is described in the answer for QUESTION NO.17.04-6, this "motor driven/diesel driven fire service pumps" will be reviewed by next expert panel explicitly to be reflected in US-APWR DCD Revision 2.

Impact on DCD

List of risk significant SSCs in US-APWR DCD, Revision 2, will be updated to include the fire suppression pumps will be updated considering the discussion of expert panel.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17 04 - Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17.04-16

The Main Control Room (e.g., 1E displays and system controls) and Remote Shutdown Panels necessary to initiate important operator actions (e.g., valve position verifications, actuation of fire suppression injection into reactor cavity) are not considered risk significant in Table 17.4-1 of the US-APWR DCD, Revision 1. The staff requests that the applicant include the main control room displays/controls and remote shutdown panels in Table 17.4-1 of the US-APWR DCD. Otherwise, provide the basis for not including these SSCs in Table 17.4-1 of the US-APWR DCD.

ANSWER:

Main control Board for US-APWR is designed to be a highly reliable SSC considering its importance to the plant safety as follows, and in PRA analysis is not considered because its failure rate is negligibly small compared to that of human errors.

- Class-1E displays and controls are fully redundant with four redundant trains
- Class-1E displays and controls meet NQA-1 QA requirements
- Safety-related components can be also operated by non-safety related display and controls with redundancy

In addition, hard-wired base diverse manual operation system is applied as a countermeasure of common cause failure according to NUREG-0800 Ch.7 BTP-19 {DI&C ISG-02, NUREG/CR-6303, SRM--SECY-91-087} .

Remote shutdown panel is not considered risk-significant for the following reason.

- it is a backup system of the main control board in the event the MCR is uninhabitable and is not considered in PRA
- it is kept isolated from HSIS while the MCR is inhabitable, and provides no impact on the plant safety and plant operation in the case of its failure

Impact on DCD

There is no impact on DCD from this RAI.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17 04 - Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17-04-17

The applicant included "software" of instrumentation and control (I&C) systems in Table 17.4-1 of the US-APWR DCD, Revision 1. However, "hardware" of these systems are not included in Table 17.4-1 of the US-APWR DCD. If the "software" is considered risksignificant, then the associated "hardware" could also be considered risk-significant. Also, uncertainties inherent with the PRA modeling of digital hardware/software are large; therefore, it is inappropriate to specifically rely on PRA models alone to show that hardware of digital systems are not risk-significant. Other methods would need to be assessed (e.g., deterministic methods, defense-in-depth, expert panel). The staff requests that the applicant include "hardware" of instrumentation and control (I&C) systems in Table 17.4-1 of the US-APWR DCD. Otherwise, provide the basis for not including hardware in Table 17.4-1 of the US-APWR DCD (in this basis include a discussion of the consideration of deterministic methods, and the expert panel's deliberation for not including hardware in D-RAP).

ANSWER:

Software of the digital instrumentation and control (I&C) system were selected as risk significant SSCs considering the impact on risk when common cause failure (CCF) of the software, which potentially lead to failure of all redundant trains; may occur. CCF of software were modeled as basic events and showed high RAW values. In the PRA, CCFs of hardware of I&C systems were represented by CCF of software. This is because CCF probabilities of software used in the PRA model were assumed to bound the CCF probability of hardware that have similar impact on the system reliability. In the PRA, CCFs of software among all redundant trains were assumed to occur with a probability of 1E-5 per demand. This probability is larger than the probability of postulated CCF of hardware that result in failure of all four redundant trains.

Since the CCFs of hardware of I&C system were not modeled as basic events for the reason explained

above, hardware of I&C systems were not identified as risk significant SSCs from the risk importance (FV/RAW) point of view.

Impact on DCD

There is no impact on DCD from this RAI.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/12/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO.101-1474 REVISION 1
SRP SECTION: 17.04 – Reliability Assurance Program (RAP)
APPLICATION SECTION: 17.4 Reliability Assurance Program
DATE OF RAI ISSUE: 11/12/2008

QUESTION NO. : 17-04-18

In accordance with SECY 95-132, Item E, structures in addition to systems and components (i.e., SSCs) should be considered for D-RAP. Also, in accordance with SECY 95-132, Item E, SSCs that are not modeled in the PRA should be considered for D-RAP. Deterministic and other methods of analysis can be used to identify the risk significant SSCs outside the scope of PRA. The reliability of SSCs that are outside the PRA study could be monitored qualitatively through operational programs. Therefore, in general, structures that house risk-significant SSCs should be included in D-RAP (e.g., reactor building, safety power source buildings, essential service water intake structure/tunnel, auxiliary building, reactor pressure vessel and internals). The staff requests that the applicant include risk-significant structures in Table 17.4-1 of the US-APWR DCD. Otherwise, provide the basis for not including these structures in Table 17.4-1 of the US-APWR DCD.

ANSWER:

MHI will discuss the consideration of SSCs that were not modeled in the PRA during the next expert panel. The list of risk significant SSCs will be updated reflecting the results of the expert panel in the next revision of the US-APWR DCD.

Impact on DCD

DCD Tier 2, Section 17.4 will be revised in Revision 2 reflecting the discussion of expert panel.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.