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TOKYO, JAPAN

October 9, 2009

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-09486

Subject: MHI's Responses to US-APWR DCD RAI No.454-3000 Revision 0

References: 1) "Request for Additional Information No. 454-3000 Revision 0, SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation, Application Section: 19.1.5," dated September 9, 2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 454-3000 Revision 0".

Enclosed are the responses to all of the RAIs that are 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 submittals. His contact information is below.

Sincerely,

Y. Ogata

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

Enclosure:

1. Responses to Request for Additional Information No. 454-3000 Revision 0

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-09486
Docket Number 52-021

Responses to Request for Additional Information No. 454-3000
Revision 0

October 9, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/9/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 454-3000 REVISION 0**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5**
DATE OF RAI ISSUE:	**9/9/2009**

QUESTION NO. : 19-398

(Question 19-293 follow-up)
DCD FSAR Section 19.1.5.1, Table 19-1-51, lists the HCLPFs for US-APWR Structures, Systems and Components (SSCs). Most of the HCLPFs are generic values derived from the EPRI Utility Requirements Document (URD), Reference 19.1-35. The staff expectation at the DC stage is that the design of structures within the scope of DC is essentially complete. Consequently, it is also expected that all the critical structural sections are identified, and the structural HCLPF values are specific to USAPWR. Also, the in-structure response spectra at all reference locations are established. Table A.3-4 of the URD lists median capacity values based on local spectral acceleration with associated composite uncertainty, βc. The URD also lists median PGA capacities that are based on assumed structural response for different soil types. The applicant has used the PGA values directly from the URD without consideration of the specific amplification of the structures included in the US-APWR Design Certification. The instructure response spectra for the PCCV, R/B, CIS and PS/B show higher amplification for some equipment locations than the generic amplification in the URD.

To verify that the generic HCLPFs are representative for the US-APWR PRA based SMA, the staff requests that the applicant compare the US-APWR in-structure spectra to the generic URD spectral acceleration capacities for bounding cases and confirm that the HCLPFs are at least 1.67 times the CSDRS.

The response to RAI 19-293 provided a portion of report MUAP-07030(R1) that contained the seismic fragility calculation for the containment structure. The staff has observed several areas where the calculation is not correct and other areas where assumptions are not justified. The staff requests the applicant to provide correction or further explanation/justification of the following items:

a) Spectral Shape Factor: The SME should be 1.67 times the CSDRS.
   NUREG/CR-0098 median spectral amplification is not applicable, thus the spectral shape factor is unity. The calculation requires correction.
b) Modeling factor: The uncertainty, βu, for frequency uncertainty is not zero as the CSDRS has a slope at the fundamental frequency of the structure. The calculation requires correction.
c) Modal Combination: Modal phasing varies with different earthquake time histories, thus βr is not zero. Ref. EPRI TR-103959 Pg. 3-19. The calculation requires correction.

d) Earthquake component combination: βr for ECC is not zero. For a vertical cylinder, two horizontal components in phase results in a vector acceleration of 1.414 times the single direction acceleration. For two directions in phase, consider this about a 1% probability and compute a value for βr for use in the fragility. Ref. EPRI TR-103959, pages 3-26 and 3-27.

e) Soil-structure interaction: 1.0 is stated in the calculation but 1.2 is used in Table 24.3-1 of the MUAP-07030(R1) PRA report. Clarify the value assumed and the calculation of fragility and the basis for the value. Also, if the SSI factor is greater than 1.0, assure that the rock case will not govern the fragility.

f) Inelastic energy absorption: A factor of 1.8 is assumed based on experience. A calculation should be done in accordance with EPRI TR-103959 assuming a story drift limit of 0.0075 as stated in Table 3-5 of EPRI TR-103959. The calculated value should be the basis for the inelastic energy absorption factor.

g) Capacity factor: The compressive stress induced by pre-stressing is included in the tangential shear capacity equation. At the basemat to cylinder interface where the maximum shear and overturning moment occur, the hoop compression is not fully developed due to the radial restraint of the basemat. Clarify and justify the basis for the prestressing compression stresses in the concrete used in the capacity calculation.

Answer:

MHI judges that the generic fragilities used in this PRA-based SMA are reasonably achieved when the design, procurement and installation of equipment are completed. Currently, the design of the US-APWR buildings is undergoing a revision. Also the new seismic responses including in-structure response spectra will be contained in DCD Rev.2 and will come to be available after issuance of DCD Rev.2. MHI would like to conduct the comparison requested by the NRC staff after in-structure spectra comes to be available. The results will be provided as an amendment of PRA report, MUAP-07030(R2) by the end of March, 2010.

For the seismic fragility analysis of containment structure, MHI will confirm the structure fragilities reflecting the NRC comment. The result will be reported in the next revision of PRA report, MUAP-07030(R2) which will be issued by December 2009.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
The results of the containment fragility analysis will be included in PRA report next revision, MUAP-07030(R2)which will be issued by December 2009. The results of other fragility analysis using revised in-structure response will be reported as an amendment of PRA report next revision, MUAP-07030(R2) by the end of March, 2010.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/9/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 454-3000 REVISION 0**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5**
DATE OF RAI ISSUE:	**9/9/2009**

QUESTION NO. : 19-399

RAI 19-296 (follow-up question)
DCD FSAR Section 19.1.5.1, Table 19-1-51 lists a HCLPF for the fuel assembly (reactor internals and core assembly) as 0.5g. No basis for this HCLPF value was provided by the applicant. However, staff review finds that if the median PGA value and composite βc in Table A.3-4 of the EPRI Utility Requirements Document (URD), Reference 19.1-35, are used, the HCLPF would be less than 0.5g PGA.

Due to the safety significance of the fuel assemblies, the staff requests the applicant justify the HCLPF values using an acceptable approach e.g., test, analyses or bounding analyses that can be evaluated by the staff and conclude that the HCLPF value of the fuel assembly and the combined reactor support arrangement is at least 0.5g.

Answer:

Currently, the stress analysis of the fuel assembly for DCD Rev.2 is not complete. MHI judges that the HCLPF capacity of the fuel assembly and the combined reactor support arrangement is at least 0.5g PGA since the system will be designed to meet the conservative requirements of ASME code and tested to IEEE standard.

MHI would like to demonstrate the HCLPF capacity of the fuel assembly is at least 0.5g using the results of stress analysis after the issuance of the stress analysis report for DCD Rev.2. Also the results of the fragility will be reported as an amendment of PRA report, MUAP-07030(R2) after the issuance of the stress analysis report.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
The results of certified HCLPF of fuel assembly will be reported as an amendment of PRA report, MUAP-07030(R2) after the issuance of stress analysis report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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APPLICATION SECTION:	**19.1.5**
DATE OF RAI ISSUE:	**9/9/2009**

QUESTION NO. : 19-400

RAI 178-1930 (Question 19-297)
DCD Section 3.10.2.1, "Seismic Qualification of Instrumentation and Electrical Equipment" describes meeting the minimum requirements of IEEE 344 (Reference 3.10-6) for seismic qualification by testing or type testing. The staff believes that if fragilities are developed for function during and after the earthquake using EPRI-TR-103959, "Methodology for Developing Seismic Fragilities," a HCLPF of 1.67 times the SSE will generally not be achieved, if only the minimum test level required by IEEE 344 is utilized. ASCE/SEI 43-05, "Seismic Design Criteria for Structures, Systems and Components," recommends that a load factor of 1.4 be applied to the required response spectrum for components qualified by test. This is to guarantee that the HCLPF will be at least as high as the SSE.

The staff requests that the applicant describe how a HCLPF of 1.67 times the SSE will be achieved by qualification testing to the requirements of IEEE 344.

Answer:

For instrumentation and electrical equipment, MHI will first determine the HCLPF capacity assuming that the equipment will be seismically qualified by testing to the IEEE 344 minimum requirements. If the HCLPF capacity turns out to be less than 0.5g PGA, MHI will apply load factors on SSE in-structure spectra to arrive at the required response spectra (RRS) in the procurement specifications. At this time, the load factors have not been completely defined but are being evaluated by component type and by method of qualification.

MHI would like to conduct this calculation after in-structure spectra comes to be available. The result will be reported as an amendment of PRA report, MUAP-07030(R2).

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
The results of certified HCLPF of electrical component will be reported as amendment of PRA report, MUAP-07030(R2) by the end of March, 2010.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/9/2009

US-APWR Design Certification

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RAI NO.:	**NO. 454-3000 REVISION 0**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5**
DATE OF RAI ISSUE:	**9/9/2009**

QUESTION NO. : 19-401

RAI 19-299 (follow-up question)
DCD Subsection 19.3.3 lists the resolution of COL Action Items relating to Chapter 19. COL Action Item 19.3 (5) states that when the design activity progresses, and specific design data become available, SSC fragilities are updated during the COLA phase to reflect design data. As discussed under Regulatory Bases above, the COLA needs to conduct a seismic PRA. Since the design of generic classes of commodities such as piping, valves, HVAC ducting, cable raceways, etc. will be conducted under a program of Design Acceptance Criteria, and the applicable Codes and Standards, their HCLPF values are to be verified under as-built condition. SSCs within the scope of certified design are expected to retain their seismic margin under as-built conditions Therefore, it is necessary to include an ITAAC to conduct a plant walk down and verify that the asbuilt SSC HPLPF values are at least equal to the 1.67 times the certified seismic design peak ground acceleration value prior to fuel load.

The staff requests that the applicant identify proposed ITAAC to provide reasonable assurance that, it the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC's regulations.

Answer:

MHI will delete the COL item 19.3(5) in DCD Revision 1.

MHI would like to perform fragility analysis using US-APWR specific in-structure spectra and the results of stress analysis to verify the HCLPFs meet the criteria as an ITAAC. The results would be reported as an amendment of PRA report, MUAP-07030(R2) within one year after the issuance of stress analysis report.

Also MHI would like to include an ITAAC to conduct plant walk down and verify the as-built SSC HCLPF values should be confirmed as at least equal to 1.67 times the certified seismic design peak ground

acceleration value prior to the fuel load.

Impact on DCD

Those issues will be described in DCD Revision 2. Tire 1 subsection 2.15, Tier 2 Table 14.3-1d and Table 19.1-115.

- Delete COL item COL 19.3(5) in page 19.3－1 and delete a sentence in the third paragraph from the bottom of page 19.1-67 of DCD Revision 1 as attachment 19-401-A.
- Revise Table 19.1-115 of DCD Revision 1 as attachment 19-401-D.

Impact on COLA

There is no impact on COLA.

Impact on PRA

The results of fragility analysis using US-APWR specific in-structure spectra and stress analysis would be reported as an amendment of PRA report, MUAP-07030(R2) within one year after the issuance of the stress analysis report.

Attachment 19-401-A: DCD Tier 2 pages 19.1-67 and 19.3-1

(Page 19.1-67)
It is not desirable that conservative SSC HCLPFs control the plant HCLPF. Conservative HCLPFs of 0.50 g are assigned to HVAC chillers (0.50 g), safety power source buildings (0.50 g), essential service water Intake structure (0.50 g), essential service water pipe tunnel (0.50 g), fuel assembly (0.50 g) and class 1E gas turbine generators (0.50 g). When the design activity progresses and specific design data becomes available, confirm that the SSC HCLPF values are greater or equal to the review level earthquake PGA.~~these HCLPFs will be updated during the COLA phase to reflect specific design data.~~

(Page 19.3-1)
COL 19.3(5) Deleted ~~When the design activity progresses and specific design data becomes available, SSC fragilities are updated during the COLA phase to reflect specific design data.~~

Attachment 19-401-D: DCD Tier 2 Table 19.1-115

Add following column in Table 19.1-115.

Key Insights and Assumptions	Dispositions
Seismic insights	
1. Table 19.1-51 provides the list of HCLPFs for US-APWR SSCs. This table demonstrates that the SSC HCLPF values are greater than 1.67 times the design basis SSE although the assessment performed by conservative generic data from EPRI URD.	19.1.5.1 Table 19.1-51
This insight will be certified by the following assessment. - Perform seismic margin assessment using US-APWR plant specific in-structure response and stress analyses. - Conduct plant walkdown to certify the SSCs retain seismic margin under as-built conditions prior to fuel loading.	3.7