MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

August 30, 2011

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

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-11281

Subject: MHI's Second Responses to US-APWR DCD RAI No. 776-5851 Revision 3 (SRP 03.07.02)

Reference: 1) "Request for Additional Information No. 776-5851 Revision 3, SRP Section: 03.07.02 – Seismic Systems Analysis," dated 06/15/2011.
2) "MHI's Responses to US-APWR DCD RAI No. 776-5851 Revision 3," UAP-HF-11262, dated 08/12/2011.

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. 776-5851, Revision 3."

Enclosed are interim responses to 10 RAIs contained within Reference 1. They are RAIs 3.7.2-70, 72, 74, 75, 76, 78, 79, 80, 82, and 84. Responses to the other 7 questions in Reference 1 were previously provided in Reference 2.

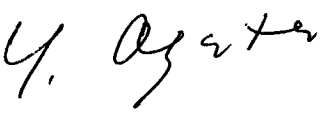
During the US-APWR NRC Weekly DCD Chapter 3 conference call, August 22, 2011, the NRC noted that an RAI cannot be closed until the associated Technical Report revision is finalized

The attached responses to RAI questions 3.7.2-70, 72, 74, 75, 76, 78, 79, 80, 82, and 84 require changes to Technical Reports MUAP-11001 and MUAP-11007. These Technical Reports also requires revision to complete seismic task force activities. As such, MHI will submit final responses to these RAIs in October 2011 following submittal of the revised Technical Reports.
In the future, MHI will provide proposed changes to Technical Reports in the same manner as proposed DCD changes. The inclusion of Technical Report markups will be considered in the determination of a 30, 45, or 90 day response.

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

D081
NRO

Sincerely,



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

Enclosure:

1. Responses to Request for Additional Information No. 776-5851, Revision 3

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

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Docket No. 52-021
MHI Ref: UAP-HF-11281

Enclosure 1

UAP-HF-11281
Docket No. 52-021

Responses to Request for Additional Information No. 776-5851, Revision 3

August, 2011

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION

8/30/2011

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

RAI NO.:	**NO. 776-5851 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic Systems Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-70:

In Subsection 2.3.1 of the MUAP-11001 (R0), "Structural Discretization and Finite Element Types," the third paragraph (page 7) states, "In order to ensure an appropriate transfer of high frequency seismic waves through the soil-structure interface, two dynamic FE models are developed with maximum element sizes in the horizontal direction of 9 feet and 13 feet."

In MHI technical report, MUAP-10006 (R1), the Applicant presents Equation (1b) on p.4 for the size of the FE mesh. For the cut-off frequency chosen to be that of the ZPA (50 Hz), the element size of 9 feet and 13 feet does not meet this equation for the 270-200 soil profile. The Applicant is requested to provide a technical basis and justification for not satisfying the element size requirement of equation (1b), in MUAP-10006(R1) in the current analysis for the A/B.

ANSWER:

Please see the response to Question RAI 03.07.02-76 below.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

Please see the response to Question RAI 03.07.02-76 below.

8/30/2011

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RAI NO.:	**NO. 776-5851 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic Systems Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-72:

Subsection 2.3.3 of MUAP-11001 (R0), "Equivalent Dynamic Mass," states that "The equivalent mass consists of permanent equipment self-weight, 25% live load and piping load (or 75% snow load for roof, whichever is greater). The loads including equipment self-weight, piping load and live load for the A/B are obtained from "Load Distribution Auxiliary Building" and "Component Weight List Auxiliary Building" (References 7.5, 7.6 respectively)."

Per SRP Acceptance Criteria D of SRP 3.7.2, in addition to the structural mass, the mass equivalent to a floor load of 50 pounds per square foot (psf) should be included in the equivalent dynamic mass. Since the staff does not have access to References 7.5 and 7.6 mentioned in the above quoted sentences, the Applicant is requested to confirm that the mass equivalent to a floor load of 50 pounds per square foot (psf) is included in the model for analyses. If this 50 psf mass is not included, the Applicant is requested to provide the technical basis and justification for its exclusion from the seismic analysis.

ANSWER:

Section 2.3.3 has been modified in Revision 1 to MUAP-11001 to state that a 50 psf dead load is now identified as being applied on all walls and slabs to account for miscellaneous minor equipment, piping, and raceways as part of the equivalent dynamic mass except those identified as having higher values per MHI Report N0-EHB0031.

Reference:

Load Distribution Auxiliary Building, Mitsubishi Heavy Industries, Ltd., N0-EHB0031, Revision 3, September 29, 2010.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on the Technical Report.

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION

8/30/2011

US-APWR Design Certification

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RAI NO.:	**NO. 776-5851 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic Systems Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-74:

Subsection 3.4 of MUAP-11001 (R0), states that "Figure 3.4-1 and Figure 3.4-2, respectively, compare the transfer function amplitudes computed for the horizontal NS and EW seismic responses at the roof elevation (El. 75.9 ft). As indicated from these figures, the correlation between the dynamic properties of the fixed-base lumped-mass stick model and that of the fixed-base FE model are reasonable for the fundamental-mode responses." The Applicant is requested to address the following staff comments:

A. The staff noticed that the information presented in Figures 3.4-1 and 3.4-2 are for the two horizontal directions. In order for the staff to assess the accuracy of the lump mass stick model in the vertical direction, the Applicant is requested to provide a figure showing the corresponding comparison of the transfer function amplitudes for the vertical direction.

B. The lumped mass stick model is used to generate the in-structure response spectra at the top of the basemat for the structural design; therefore, the accuracy of the lumped mass stick model is essential for the structural design. In the above quoted sentence, the Applicant stated that the lumped mass stick model is reasonable for the fundamental-mode response. The Applicant is requested to provide the technical basis and justification to demonstrate that the contribution from the higher modes is negligible and the result is conservative.

C. In order for the staff to assess the accuracy of the lumped mass stick model, the Applicant is requested to provide a table comparing the modal properties for the lumped mass stick model and the FEM model in the x, y and z directions. The data should include the modal frequencies, mass participation factors, and the cumulative modal participating mass in percentage of the total mass up to the 90 percent of the total mass.

ANSWER:

A. The transfer function in the vertical direction will be added in MUAP-11001, Revision 2.

B. The FE model, instead of the LMSM, is used in MUAP-11001, Revision 2, to obtain the ISRS at the top of the basemat. ISRS were computed for the response motions at the center and four extreme edge nodes. The resulting ISRS for all generic site soil profiles shown in Figures 4.2-9 through 4.2-11 will be updated in MUAP-11001, Revision 2.

C. The FE model will be used in MUAP-11001, Revision 2, as the only design basis model.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

A revision to the Technical Report is required to support the substance of this RAI response. A mark-up of the Technical Report will be provided to the NRC as supplementary information to this response in conjunction with the issuance of MUAP-11001 Revision 2, which is scheduled for October 2011.

8/30/2011

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APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-75:

In Subsection 4.1 of MUAP-11001 (R0), "Methodology," the fourth paragraph (page 41) states, "Table 4.2-1 provides a summary of the dynamic models, site profiles, number of frequencies of analyses and cut-off frequency of analyses used for the different SSI analyses presented in this report. The horizontal size of the FE mesh of the basemat is also presented in the table together with the maximum frequency of the waves that can be transmitted through the soil-foundation interface based on the criterion that the basemat FE size is not more than 20% of the minimum wave length."

The ZPA for the CSDRS is 50 Hz. The staff noticed that for several soil profiles, the data for the maximum wave passage frequency presented in Table 4.2-1 are much less than 50 Hz. The SRP Acceptance Criteria 1.A (1) of SRP 3.7.2 states, "all modes with frequencies less than the ZPA (or PGA) frequency of the corresponding spectrum are adequately represented in the dynamic solution." Both the lumped mass stick model and the FE model used in the report do not meet this criterion for soft soil profiles. The Applicant is requested to revise their methodology or to provide the technical basis and justification to demonstrate that their approach is conservative.

ANSWER:

Please see the response to question RAI 03.07.02-76 below.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

Please see the response to Question RAI 03.07.02-76 below.

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION

8/30/2011

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Docket No. 52-021

RAI NO.:	**NO. 776-5851 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic Systems Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-76:

In Subsection 4.3 of MUAP-11001 (R0), "Results of Dynamic FE Model SSI Analyses," the third paragraph (page 55) states, "These SASSI models are shown in Figure 2.3-1 through Figure 2.3-3 for the 9-ft-mesh model, which is used for the critical 270-500 site profile case, and in Figure 2.3-4 through Figure 2.3-12 for the 13-ft-mesh model, which is used for the critical 900-100, 900-200, and 2032-100 site profile cases."

The data shown in Table 4.2-1 of the report indicate that the maximum wave passage frequency for the 9-ft-mesh model is 27.9 Hz which is less than the ZPA frequency of 50 Hz. The Applicant is requested to provide the technical basis and justification to demonstrate that the contribution from the higher modes is negligible and the result is conservative.

ANSWER:

Please refer to the response for RAI No. 660-5134, Revision 2, Question 03.07.02-57 for a detailed explanation of the criteria used for selecting the maximum frequencies of analysis and an explanation of the criteria used to determine the ability of the ACS SASSI site model layers to transmit seismic waves with frequencies up to the maximum frequency of interest.

The cut-off frequencies of the SSI analyses of different generic soil profiles considered are set at values that ensure that the results of the SSI analyses envelope the response at frequencies up to 50 Hz. A study performed for the PS/B (see the response to RAI No. 660-5134, Revision 2, Question 03.07.02-57), which increased the cut-off frequency from 33 Hz to 50 Hz for two of the softer soil profiles, showed that increasing the cut-off frequency for softer profiles did not capture any additional high frequency effects beyond those enveloped by the hard rock profile.

Figures 3.2-1 and 3.2-2 of MUAP-11001, Revision 1, shows the horizontal X and Y cumulative modal mass vs. frequency plots for the fixed-base dynamic FE model show fixed-base-model cut-off frequency, defined as the cumulative modal mass achieving 95% of the total mass, being about 24 to 25 Hz which are similar to the maximum wave passage frequencies. The similar plot for the vertical direction shows fixed-base-model cut-off frequency for the vertical analysis at about 48 to 50 Hz. Thus, the cut-off frequencies of the dynamic models supported on the generic site profiles, which are softer than the fixed-base condition, should be lower than the fixed-base-model cut-off frequencies indicated above and thus lower than the wave passage frequencies. The contribution from higher modes will be negligible.

Section 2.3.1 of Revision 1 to MUAP-11001 indicates that only one FE model with a maximum element size in the horizontal direction of 9 feet is now employed in the SSI analyses. Table 4.2-1 will be revised in Revision 2 to MUAP-11001 to show the resulting maximum wave passage frequencies and corresponding analysis cut-off frequencies.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

A revision to the Technical Report is required to support the substance of this RAI response. A mark-up of the Technical Report will be provided to the NRC as supplementary information to this response in conjunction with the issuance of MUAP-11001 Revision 2, which is scheduled for October 2011.

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION

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Docket No. 52-021

RAI NO.:	**NO. 776-5851 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic Systems Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-78:

In Subsection 5.1.5 of MUAP-11001 (R0), "SSE Loads (E_{ss})," the third paragraph (page 59) states, "Therefore, in addition to the earthquake forces derived from RSA analyses, the effects of accidental torsion is also considered. A torsion moment equal to the larger of the torsions resulting from the product of the base shears times 5% of the building dimension that is perpendicular to the direction of the base shear force is applied to the analytical model."

The Applicant is requested to confirm that the effect of accidental torsion is included in the calculation of the displacement relative to the free-field ground motion. If this torsional effect was not included, the Applicant is requested to provide the technical basis and justification for its exclusion in determining the maximum relative displacements.

ANSWER:

Applying torsion moments as described in Subsection 5.1.5 to account for accidental torsion ensures that the in-plane design shear forces in the shear walls of the structure are conservative and envelope the actual shear forces due to torsion the structure could experience. This addresses a prime concern associated with accidental torsion effects and is consistent with Acceptance Criteria 11 of SRP 3.7.2, which identifies that the use of static factors to account for accelerations due to torsion is an acceptable approach.

Due to the analytical complexities in including static torsion moments in SSI time history analyses, accidental torsion effects were not included in the displacements relative to the free-field ground motion given in Section 4.3 of MUAP-11001. These displacements are presented to confirm the adequacy of the SSI analyses and to aid in identifying the controlling site profile. Using the results from the controlling site profiles from all the nuclear island structures, separate gap analyses will be performed in a separate calculation to evaluate the adequacy of the gaps between the buildings. The pertinent results and conclusions of these analyses will be included in Revision 2 to MUAP-11001.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

A revision to the Technical Report is required to support the substance of this RAI response. A mark-up of the Technical Report will be provided to the NRC as supplementary information to this response in conjunction with the issuance of MUAP-11001 Revision 2, which is scheduled for October 2011.

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION

8/30/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 776-5851 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic Systems Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-79:

In Section 1.0 of the MUAP-11001 (R0), it is stated that response spectrum analysis (RSA) is used to obtain static and dynamic demands of the major representative structural members of A/B. The ISRS at A/B basemat resulting from lumped-mass stick model SSI analysis is used as the input response spectrum for RSA.

In Subsection 5.2.1 of MUAP-11001 (R0), "Determination of the Input Response Spectrum," (page 63), the Applicant listed five steps used for calculating the In-Structure Response Spectra (ISRS). The staff reviewed the five-step procedure and was not able to identify the step that includes the base rocking motion in the ISRS generation. SRP Acceptance Criteria 1.A.iii of Section 3.7.2 requires consideration of rocking response of site structures and their foundations. As a result of soil-structure interaction, the superstructure experiences an additional rocking motion at its base, and the effect of this rocking motion should be considered in the generation of ISRS.

The Applicant is requested to provide technical details that show how this rocking motion is included in generating the ISRS. If this rocking motion is not included, the Applicant is requested to provide the technical basis and justification that demonstrates that the seismic displacements and design forces of A/B structure based on the analyses using the ISRS (that are generated excluding the rocking motion) are conservative.

ANSWER:

The seismic displacements are obtained directly from the SSI analyses of the 3-D FE model and as such include the effects of the response for all six degrees of freedom. The broadened ISRS used as input to calculate seismic demands for evaluation of structural members incorporate the amplifications of the translation responses due to rotational response of the basemat. Namely, the site-independent SSI analyses provided the responses at the four corners of the basemat that are used for generation of the ISRS. The responses due to the three direction of the earthquake at each corner of the basemat are first combined using SRSS as discussed in Step 2 of Subsection 5.2.1. As such the ARS for three translational degrees of freedom incorporate the amplifications of the responses due to rotational response of the basemat (rocking and torsion). The ARS obtained for all generic soil cases at all four locations are enveloped and then broadened.

Site-independent SSI analyses will be performed on the A/B dynamic FE model for all generic soil cases considered for the US APWR standard design. The displacements at selected nodes will be computed from the SSI analyses and compared to the corresponding results from RSA to demonstrate that the RSA provides conservative estimates of the demands for seismic design of structural members. . This will be documented in revision 2 to MUAP-11001.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

A revision to the Technical Report is required to support the substance of this RAI response. A mark-up of the Technical Report will be provided to the NRC as supplementary information to this response in conjunction with the issuance of MUAP-11001 Revision 2, which is scheduled for October 2011.

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US-APWR Design Certification

Mitsubishi Heavy Industries

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RAI NO.:	**NO. 776-5851 REVISION 3**
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APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-80:

In Subsection 5.2.3 of MUAP-11001 (R0), "Combined Modal Responses: Lindley-Yow Method," the paragraph (page 63) states, "The periodic response portion of the Lindley-Yow method is implemented by using ANSYS "Grouping Method" and the rigid response portion is implemented by using "Static ZPA Method" per Regulatory Position 1.4.2 of RG 1.92, Rev. 2. The directional effect from each direction is combined by 100-40-40 method."

The staff noticed that so far the Applicant has not reported the use of the Lindley-Yow method for combining modal responses in the DCD (Rev. 3) and in seismic analyses reports of various category I structures and the Turbine building. The applicant is requested to discuss the unique circumstances and aspects of the A/B seismic analyses that require the use of Lindley-Yow method for combining modal responses. In RG. 1.92, one limitation on the use of Lindley-Yow's method is specified, "The Lindley-Yow's method should not be used for SSCs that have natural frequencies less than the frequency of the lowest-frequency spectral acceleration peak."

Thus, the applicant is requested to discuss the effect of the Lindley-Yow's method limitation on the seismic analyses responses. The Applicant is also requested to discuss how the periodic response component is combined with the rigid response portion and provide the technical basis and justification for the combination used.

ANSWER:

Although Lindley-Yow method is not directly mentioned in the DCD, it is implicitly included in Regulatory Guide 1.92. The Lindley-Yow method is indirectly referenced in the DCD, however, as the third paragraph of Section 3.7.2.7 of the DCD, Revision 3, states the following:

> "When the response spectra method of analysis is used (see Subsection 3.7.3.1 for a discussion of response spectra methods of analysis), modal responses have been combined by one of the RG 1.92, Rev.2 (Reference 3.7-27), methods, or by the 10% grouping method described below. In some applications, the more conservative modal combination methods contained in Rev.1 of RG 1.92 (Reference 3.7-28) are also used, as permitted in Revision 2 of RG 1.92 (Reference 3.7-27)."

Since the Lindley-Yow method is one of the methods cited by RG 1.92 its use is consistent with the DCD.

The Lindley-Yow method was chosen for use for the response spectrum analyses of the A/B because it was supported by ANSYS and analyses of other Category I structures indicated a potential for the presence of both periodic and rigid response modes.

The seismic response is calculated using the Lindley-Yow method described in NRC Regulatory Guide 1.92, and in NUREG/CR-6645. The Lindley-Yow method divides the total seismic response into two components: response in-phase with the ground motion and response out-of-phase with the ground motion.

A typical seismic response spectrum can be divided into three regions as shown in Figure 1 below. Defining f_{SP} as the frequency corresponding to the peak spectral value on the response spectrum curve and f_{ZPA} as the frequency corresponding to the zero-period ground acceleration (ZPA), the regions can be categorized as follows:

- Modes having a frequency less than f_{SP} (low-frequency range) are predominately out-of-phase with the ground motion and thus have no contribution to the in-phase response.
- For modes having a frequency between f_{SP} and f_{ZPA} (mid-frequency range), there are contributions to both the in-phase and out-of-phase responses.
- Modes having a frequency greater than f_{ZPA} (high-frequency range) are in-phase with the ground motion.

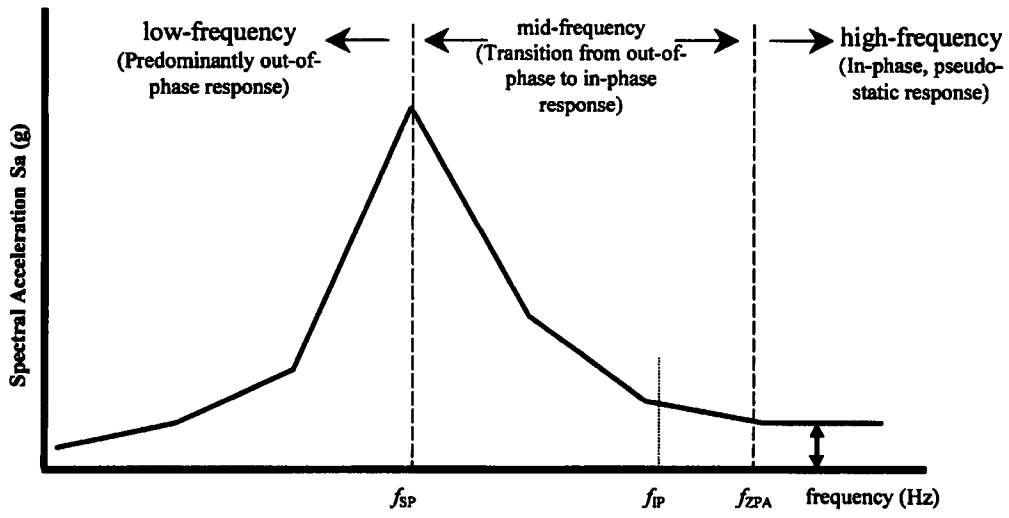

Figure 1 Depiction of Lindley-Yow Response Spectrum

The total in-phase response is calculated by performing a static analysis in which the zero period ground acceleration (ZPA) is applied to the total in-phase mass. This procedure automatically accounts for the so-called "missing mass", or that portion of the structural mass that does not participate in the amplified modal responses.

The out-of-phase response is determined by performing a response spectrum analysis combining the response of modes having a frequency less than or equal to the frequency corresponding to the ZPA (f_{ZPA}). Modified spectral accelerations, $S'_{ai} = S_{ai}\sqrt{1-\alpha_i^2}$ are used in the analysis, where S_{ai} equals the unmodified spectral acceleration for mode "i". For modes which have a frequency less than f_{SP} (low-frequency range) and are predominately out-of-phase with the ground motion, $\alpha_i = 0$, which specifically addresses the limitation on the use of the Lindley-Yow method discussed in Regulatory Position C.1.3.2 of RG 1.92. For modes having a frequency between f_{SP} and f_{ZPA} (mid-frequency range), $\alpha_i = ZPA/S_{ai}$. Out-of-phase modal responses are summed using the Grouping method. The lowest dominant frequency of the AB structure in each direction (x,y and z direction) is greater than f_{SP}.

The total seismic response is calculated as the SRSS of the in-phase and out-of-phase components.

Figures 5.2-4 through 5.2-6 of MUAP-11001, Revision 1, show comparisons of the unmodified response spectra with the response spectra with the Lindley – Yow modifications. A more detail discussion of the combination of periodic response component and rigid component using the Lindley-Yow method will be added to Revision 2 of MUAP-11001.

References:

Combining Modal Responses and Spatial Components in Seismic Response Analysis (Regulatory Guide1.92), Rev. 2, U.S. Nuclear Regulatory Commission, July 2006.

Reevaluation of Regulatory Guidance on Modal Response Combination Methods for Seismic Response Spectrum Analysis (NUREG/CR-6645), Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1999.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

A revision to the Technical Report is required to support the substance of this RAI response. A mark-up of the Technical Report will be provided to the NRC as supplementary information to this response in conjunction with the issuance of MUAP-11001 Revision 2, which is scheduled for October 2011.

8/30/2011

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RAI NO.:	**NO. 776-5851 REVISION 3**
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APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-82:

In Table 5.5-3 of MUAP-11001 (R0), "Typical Structural Demands," (page 78) the second item states that, "1< DCR [Demand/Capacity Ratio] <2 for wall above and below 3rd floor."

Since the demand exceeds the capacity for this wall, the wall will need to be redesigned. The Applicant is requested to show how these exceedances are factored into the design, and in the calculation of the relative displacements between the A/B and R/B and the A/B and PS/B; and in demonstrating that the relative displacement is within the acceptable limits.

ANSWER:

Table 5.5-3 indicates the exceedences occur in the wall out-of-plane shear while Figure 5.5-3 shows they occur in a few isolated areas of the wall. Some of these areas are located within the distance "d" from the face of the interfacing slab where the shear force could be reduced to that occurring at the distance "d" as specified in Section 11.1.3.1 of ACI 349 and would thus lower the demands. At the other areas, the Demand/Capacity ratios could be reduced to below 1 with the addition of shear reinforcement to those local areas that are overstressed. This would have very little impact on the stiffness of the walls. The relative displacements would not be impacted by this modification.

From the demand capacity ratio for other reactions and from the current reinforcement ratio, it appears that the overall wall design is adequate and local modification is feasible and can be implemented in the detail design phase, if required by the final analyses that will be documented in MUAP-11001, Revision 2.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

A revision to the Technical Report is required to support the substance of this RAI response. A mark-up of the Technical Report will be provided to the NRC as supplementary information to this response in conjunction with the issuance of MUAP-11001 Revision 2, which is scheduled for October 2011.

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION

8/30/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 776-5851 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic Systems Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**06/15/11**

QUESTION NO. RAI 03.07.02-84:

In Subsection 5.1.3 of MUAP -11001 (R0), the Applicant stated that to simplify the calculations, the groundwater level is conservatively taken as at grade level for determination of hydrostatic pressure.

However, the Applicant did not address the effect of water table on the SSI seismic analysis of the A/B. The applicant is requested to include the effects of water table in seismic analyses or provide the technical bases including supporting analyses for neglecting the effects of the high water table on the seismic design and analyses for the A/B.

ANSWER:

The site-independent SSI analyses of A/B are performed on generic soil profiles that represent dynamic properties of generic sites with saturated soil. An evaluation is being performed on effects of water table fluctuations on the standard design of Seismic Category I buildings. Preliminary results of the study show the water table fluctuations have negligible effects on seismic demands for standard design of structural members. The results will be documented in MUAP-11007, Revision 1.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

Issuance of Revision 1 of Technical Report MUAP-11007 is required to support the substance of this RAI response. Analyses results to be contained in Revision 1 to MUAP-11007, which is scheduled to be issued in October 2011, will be used to provide the supplementary information to this response.