

  
**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
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TOKYO, JAPAN

September 18, 2012

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-12258

**Subject: MHI's Response to US-APWR DCD RAI No. 950-6575 (SRP 03.07.03)**

References: 1) "Request for Additional Information No. 950-6575," dated July 16, 2012

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 950-6575."

Enclosed is the response to the question contained within Reference 1.

This response will be supplemented subsequent to the submittal of TR MUAP-10006, Revision 3, in accordance with the schedule as defined in the updated Seismic Closure Plan letter, UAP-HF-12238, dated August 29, 2012.

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittal. His contact information is below.

Sincerely,



Yoshiki Ogata,  
Director, APWR Promoting Department  
Mitsubishi Heavy Industries, LTD.

D081  
NRD

Enclosures:

1. Response to Request for Additional Information No. 950-6575

CC: J. A. Ciocco  
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Enclosure 1

UAP-HF-12258  
Docket No. 52-021

Response to Request for Additional Information No. 950-6575

September 2012

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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9/18/2012

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

**RAI NO.:** 950-6575 REVISION 3  
**SRP SECTION:** 03.07.03 - Seismic Subsystem Analysis  
**APPLICATION SECTION:** 3.7.3  
**DATE OF RAI ISSUE:** 07/16/2012

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**QUESTION NO. RAI 03.07.03-12:**

In US-APWR DCD (R3) Section 3.7.5, Combined License Information, it is stated in COLA Item 23 that, "The COL Applicant is to verify that the results of the site-specific SSI analysis for the broadened ISRS and basement walls lateral soil pressures are enveloped by the US-APWR standard design." The staff notes that the criteria for evaluating whether COLA Item 23 is satisfied are not provided. Therefore, the staff requests MHI to describe the quantitative evaluation criteria that a COL applicant would use to demonstrate satisfaction of COLA Item 23, and also identify specific locations at which comparison of site-specific ISRS will be made with the US-APWR standard design ISRS. The locations identified for ISRS comparisons should include peripheral locations to detect rocking and torsion, locations that experience the largest amplification of the ground motion, and locations of key systems and equipments. The criteria should include detailed specific steps that may be taken (e.g., additional analyses to demonstrate the acceptability of the design if the responses are not enveloped) by the COL applicant. The US-APWR standard design applicant is requested to provide the detailed evaluation criteria for all potential scenarios including the following.

- (1) A hard rock high frequency (HRHF) site, where the site-specific GMRS exceeds the CSDRS in the high frequency range;
  - (2) A site where the site-specific GMRS exceeds the CSDRS in the low and /or in mid-frequency range;
  - (3) A site where the site-specific GMRS is enveloped by the CSDRS, but the site-specific soil conditions are not enveloped by the generic soil profiles.
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**ANSWER:**

The criteria established to support the COL Applicants to address COL Item 3.7(23) for the In-Structure Response Spectra and earth pressures for the different conditions identified in the RAI are described below.

### In-Structure Response Spectra (ISRS)

The COL Applicant will satisfy the COL Item 3.7(23) criteria for ISRS if the broadened site-specific ISRS, at specified locations, are enveloped by the corresponding standard design ISRS for frequencies from 0.1 to 100 Hz. The comparisons of the following ISRS are required:

1. 5% damped ISRS of responses of the corners of the reactor building (R/B) complex at the top of basemat elevation, ground floor elevation and roof elevations to detect rocking and torsion of the building as well as the possible amplifications at plant grade due to embedment effects.
2. 5% damping ISRS for node locations at the top of the prestressed concrete containment vessel (PCCV) and node locations within the containment internal structure where the largest amplifications of the ground motion is experienced
3. Design ISRS for the key systems and equipment identified in Table 1. The site-specific ISRS for each of the specified systems and equipment are developed for specified damping by grouping the responses at multiple nodal locations following the methodology used for development of standard design ISRS. Unlike the 5% damped ISRS described in Items 1 and 2 above that serve to capture the overall response of the building, these ISRS serve as input for design of the particular equipment and systems and have the valleys filled in as will be described in Technical Report MUAP-10006, Rev. 3.

The standard design ISRS that serve as the basis for COL Item 3.7(23) comparisons will be based on the results of the site-independent soil-structure interaction (SSI) analyses of the R/B complex dynamic finite element (FE) model that will be presented in Technical Report MUAP-10006, Rev. 3. The specific ISRS used for comparison will be included in the DCD per the Seismic Closure Plan.

### Basement Walls Lateral Earth Pressures

The COL Applicant will satisfy the earth pressure enveloping criteria if the site-specific earth pressure demands on the basement exterior walls are enveloped by the standard design earth pressure loads. . The distribution and the magnitudes of the standard design earth pressure loads will be updated to match the re-configured US-APWR plant and include earth pressure loads generated by foundation sliding and structure-soil-structure interaction. The standard design earth pressure loads will be presented in Technical Report MUAP-10006, Rev. 3. The updated values will also be added as a figure and table in the DCD per the Seismic Closure Plan.

### Evaluation Criteria

Regardless of the site-specific soil conditions, the COL Applicant can demonstrate the applicability of the standard seismic design of the R/B complex and seismic category I and II equipment without performing any additional evaluations if the above criteria for ISRS and earth pressures are met.

The following COL Item 3.7(23) evaluation criteria are applicable for the following potential scenarios:

- (1) A hard rock high frequency (HRHF) site, where the site-specific ground motion response spectra (GMRS) / foundation input response spectra (FIRS) exceed the certified seismic design response spectra (CSDRS) in the high frequency range

- a. Validation of Standard Plant Equipment and Components The standard seismic design is valid for the seismic category I and II equipment for which site-specific ISRS are enveloped by the corresponding standard design ISRS at frequencies from 0.1 to 100 Hz. The COL Applicant must re-validate by either re-analyzing or re-qualifying equipment potentially affected by ISRS exceedances. If re-validation cannot be achieved, the COL Applicant must replace the standard design equipment with a documented departure.
- b. Validation of Standard Plant Category I Structures The standard seismic designs of R/B complex can be demonstrated without performing additional structural evaluations only if:
  - The shear and axial force diagrams developed based on results of site-specific SSI analyses of R/B complex are enveloped by the corresponding diagrams of standard design safe-shutdown earthquake (SSE) loads.
  - The local out-of-plane site-specific seismic demands on R/B complex slabs and walls are enveloped by the corresponding standard design SSE loads.
  - Site-specific lateral soil pressure demands on basement walls must be enveloped by the standard design basement walls lateral soil pressures.

Any re-analysis or re-design of those R/B complex structural elements that are affected by higher demands shall be documented as a departure by the COL Applicant.

(2) A site where the site-specific GMRS exceeds the CSDRS in the low and/or in mid-frequency range

- a. Validation of Standard Plant Equipment and Components The standard seismic design is valid for the seismic category I and II equipment for which site-specific broadened ISRS are enveloped by the corresponding standard design broadened ISRS at frequencies from 0.1 to 100 Hz. The COL Applicant must re-validate by either re-analyzing or re-qualifying equipment potentially affected by ISRS exceedances. If re-validation cannot be achieved, the COL Applicant must replace the standard design equipment with a documented departure.
- b. Validation of Standard Plant Category I Structures The standard seismic designs of R/B complex structures can be demonstrated without performing additional structural evaluations only if:
  - The shear and axial force diagrams developed based on results of site-specific SSI analyses of R/B complex are enveloped by the corresponding diagrams of standard design SSE loads.
  - The local out-of-plane site-specific seismic demands on slabs and walls are enveloped by the corresponding standard design SSE loads.
  - Site-specific lateral soil pressure demands on basement walls are enveloped by the standard design basement walls lateral soil pressures.

If envelopment of any of the seismic demands is not achieved, re-analysis and/or re-design of structural elements that are affected by higher demands is required, and shall be documented as a departure by the COL Applicant.

- (3) A site where the site-specific GMRS is enveloped by the CSDRS, but the site-specific soil conditions are not enveloped by the generic soil profiles
- a. Validation of Standard Plant Equipment and Components The site-specific broadened ISRS at the specified locations must be enveloped by the corresponding standard design broadened ISRS at frequencies from 0.1 to 100 Hz to demonstrate applicability of the standard design of seismic category I and II equipment and components. If any of these site-specific ISRS is not enveloped, all ISRS used for design of equipment and components must be compared. The COL Applicant must re-validated by either re-analyzing or re-qualifying equipment potentially affected by ISRS exceedances. If re-validation cannot be achieved, the COL Applicant must replace the standard design equipment with a documented departure.
  - b. Validation of Standard Plant Category I Structures The standard seismic designs of seismic category I structures are valid if the specified site-specific ISRS are enveloped by the corresponding standard design ISRS and site-specific design pressure demands are enveloped by the standard design earth pressure loads. If any of the site-specific ISRS specified in Tables 1 and 2 are not enveloped, the standard seismic design of R/B complex structures can be demonstrated without performing additional structural evaluations only if:
    - The shear and axial force diagrams developed based on results of site-specific SSI analyses of R/B complex are enveloped by the corresponding diagrams of standard design SSE loads.
    - The local out-of-plane site-specific seismic demands on slabs and walls are enveloped by the corresponding standard design SSE loads.
    - Site-specific lateral soil pressure demands on basement walls must be enveloped by the standard design basement walls lateral soil pressures.

If envelopment of seismic demands is not achieved, re-analysis and re-design of structural elements that are affected by higher demands is required, and shall be documented as a departure by the COL Applicant.

The shear and axial force diagrams of standard design SSE loads, as well as the local out-of-plane SSE loads used for the comparisons will be presented in Technical Report MUAP-10006, Rev. 3 and will be included in the DCD per the Seismic Closure Plan.

**Table 1, ISRS for Design of Key Components and Equipment**

No.	Equipment/Component	ISRS Damping	Location	
			Structure	Elevation (ft)
1	Reactor Vessel Support	3%	Containment Internal Structure Center	35.90

<b>2</b>	Sump Strainer Supports	3%	Containment Foundation	2.58
<b>3</b>	Steam Generators Lower Supports	3%	Containment Internal Structure	45.64
<b>4</b>	Steam Generators Upper Supports	3%	Containment Internal Structure	96.583
<b>5</b>	Spent Fuel Pool	4%	R/B-FH/A	25.25
<b>6</b>	New Fuel Storage Pit	4%	R/B-FH/A	63.33
<b>8</b>	Gas Turbine Generator power source building (PS/B) - E-AAC	5%	East PS/B	2.583
<b>9</b>	Gas Turbine Generator PS/B - W-B	5%	West PS/B	2.583

**Impact on DCD**

There is no current impact on the DCD. However, the DCD will be updated in accordance with the Seismic Closure Plan, which was submitted August 29, 2012 (MHI Letter UAP-HF-12238).

**Impact on R-COLA**

The R-COLA will need to be revised to address the updated standard plant soil pressures and ISRS as required by COL Item 3.7(23).

**Impact on S-COLA**

The S-COLA will need to be revised to address the updated standard plant soil pressures and ISRS as required by COL Item 3.7(23).

**Impact on PRA**

There is no impact on the PRA.

**Impact on Technical/Topical Report**

Technical Report MUAP-10006 is being revised in accordance with the Seismic Closure Plan.