MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

November 19, 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-12295

Subject: MHI's Response to US-APWR DCD RAI No. 958-6608 (SRP 03.08.03)

References: 1) "Request for Additional Information No. 958-6608," dated September 5, 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. 958-6608."

Enclosed are the responses to questions 03.08.03-93, 03.08.03-95, and 03.08.03-96, contained within Reference 1. The responses to questions 03.08.03-90, 03.08.03-91, 03.08.03-92, and 03.08.03-94 will be provided in a separate letter.

As indicated in the enclosed materials, this document contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

This letter includes a copy of the proprietary version (Enclosure 2) of the response, a copy of the non-proprietary version (Enclosure 3) of the response, and the Affidavit of Yoshiki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all materials designated as "Proprietary" in Enclosure 2 be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

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,

Y. Ogata

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

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NRO

Enclosures:

1. Affidavit of Yoshiki Ogata

2. Response to Request for Additional Information No. 958-6608 (Proprietary version)

3. Response to Request for Additional Information No. 958-6608 (Non-proprietary version)

CC: J. A. Ciocco
J. Tapia

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Docket No. 52-021
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Enclosure 1

MITSUBISHI HEAVY INDUSTRIES, LTD.
AFFIDAVIT

I, Yoshiki Ogata, state as follows:

1. I am Director, APWR Promoting Department, of Mitsubishi Heavy Industries, LTD ("MHI"), and have been delegated the function of reviewing MHI's US-APWR documentation to determine whether it contains information that should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential.

2. In accordance with my responsibilities, I have reviewed the enclosed document entitled "Response to Request for Additional Information No. 958-6608" dated November 2012, and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages containing proprietary information are identified with the label "Proprietary" on the top of the page and the proprietary information has been bracketed with an open and closed bracket as shown here "[ ]". The first page of the document indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The information identified as proprietary in the enclosed document has in the past been, and will continue to be, held in confidence by MHI and its disclosure outside the company is limited to regulatory bodies, customers and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and is always subject to suitable measures to protect it from unauthorized use or disclosure.

4. The basis for holding the referenced information confidential is that it describes the unique design and methodology developed by MHI as it provides the analytical and testing basis for the qualification of steel concrete modules.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:

   A. Loss of competitive advantage due to the costs associated with the development of the unique design parameters.

B. Loss of competitive advantage of the US-APWR created by the benefits of the steel concrete module design.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information and belief.

Executed on this 19th day of November, 2012.

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

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Enclosure 3

UAP-HF-12295
Docket No. 52-021

Response to Request for Additional Information No. 958-6608

November 2012

(Non-proprietary version)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/19/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **No. 958-6608**

SRP SECTION: **03.08.03 – Concrete and Steel Internal Structures of Steel or Concrete Containments**

APPLICATION SECTION: **03.08.03**

DATE OF RAI ISSUE: **9/5/2012**

QUESTION NO. RAI 03.08.03-93:

The staff evaluated the applicant's response to RAI 858-6126, Question 03.08.03-45, dated February 28, 2012, regarding the comparison of the material and geometric parameters used in the US-APWR CIS to the parameters of the test specimens. The RAI response addressed most of the staff's concerns. However, as requested in the RAI, the applicant needs to provide the results/conclusions of the tests. For each test, provide the discussion on how these results/conclusions support the analytical modeling approach and design aspects of the SC members. In addition, provide the test summary reports available for various component tests if they are not included in MHI TR MUAP-11005-P (R0), e.g., the Korean out-of-plane shear tests presented in Table 5 of the response.

ANSWER:

The experimental database provided in the response to RAI 858-6126, Question 03.08.03-45 will be included in the revision to MHI Technical Report MUAP-11005-P (R1).

Additionally, as requested by this and the referenced RAI questions, the database will be improved to include brief discussions of: (i) the experimental results and conclusions, and (ii) their applicability and support of the US-APWR Steel-Concrete (SC) wall analytical modeling and design approach as outlined in MHI Technical Reports MUAP-11018 and MUAP-11019, respectively.

However, as explained in the clarification call on 08/30/2012, the discussions will be presented for small groups of tests with common test objectives and similar results, rather than for each of the 94 individual test specimens presented in the experimental database.

An example of such discussion is provided for reference. This is not the final draft or format of the discussion that will be provided in the revision to MUAP-11005-P (R1), but an example of the same.

Figure 03.08.03-93-1 shows Table 8 provided as part of the experimental database in response to RAI 858-6126, Question 03.08.03-45. This table presented the database of in-plane shear tests conducted on SC wall panels. Table 8 includes experimental results from Kitano et al. 1997 and Osuga, et al. 2000 (References 12 and 13, respectively, as listed in Table 1 of the experimental database). The discussion below focuses on the specimens tested by Kitano et al. 1997 (Reference 12).

Specimens S200NN, S215NN, and S230NN are identical with the exception that they are subjected to zero axial force, compressive axial force equal to 353 kN, and compressive axial force equal to 706 kN, respectively. These axial compressive forces are small because they produce axial compressive stress (σ) calculated as the compressive force divided by concrete area equal to 1.5 MPa and 3.0 MPa, respectively.

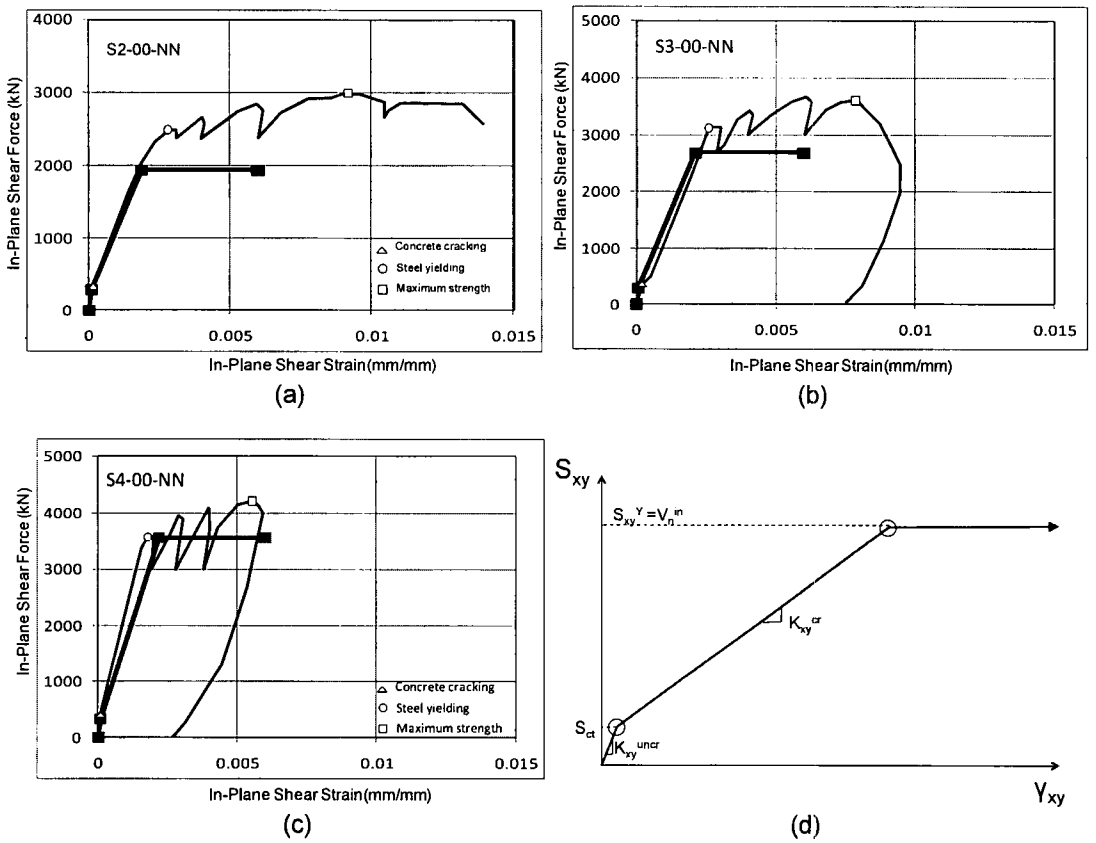

Figure 03.08.03-93-3. Experimental Results and Analytical Predictions for In-Plane Shear Specimens: (a) S200NN, (b) S300NN, (c) S400NN, and (d) Tri-linear Prediction Model Developed in MUAP-11018 Appendix A.

Specimens S200NN, S300NN, and S400NN were subjected to pure in-plane shear (with zero axial compression). The tests were conducted cyclically, and the envelopes of the measured cyclic in-plane shear force-shear strain (V-γ) responses are shown in Figure 03.08.03-93-3. The figure also includes comparisons with the predicted tri-linear in-plane shear force-shear strain responses for the specimens, the details of which were presented in Appendix A of MUAP-11018. These comparisons were also shown in Appendix B of MUAP-11018.

Section 4 of MUAP-11018 explains how the initial, tangent, and secant stiffness calculated using the tri-linear in-plane shear force-shear strain response are used to define the stiffness of the cracked and uncracked SC walls of US-APWR Containment Internal Structure. Additional, numerical comparisons of the predicted and measured initial and post-cracking stiffness of these specimens are included in Appendix B of MUAP-11018.

Figure 03.08.03-93-4 shows additional comparisons of the experimental results for the seven specimens (S200NN, etc. as listed above) with those calculated using Equation 7.3-1 in MUAP-11019. The comparison focuses on the in-plane shear strength (S_{xy}^{Y}) corresponding to Von Mises yielding of the steel faceplates. These comparisons were also included in Chapter 7 of MUAP-11019.

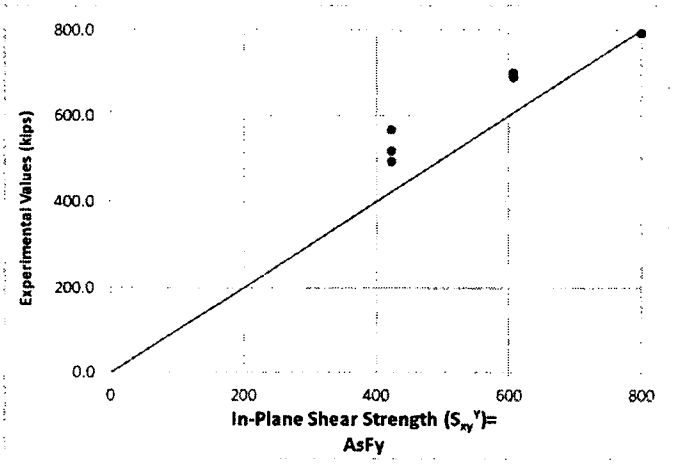

Figure 03.08.03-93-4. Comparison of Experimental In-Plane Shear Strength with Values Calculated using Equation 7.3-1 in MUAP-11019.

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

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 Reports

MUAP-11005 will be revised to include the experimental database tables in Attachment 5 of the response to RAI 858-6126 Question 03.08.03-45, as an appendix. In addition, this appendix will include written summaries of the test results and their support of the US-APWR SC wall analysis and design methodology, as discussed in this response.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/19/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **No. 958-6608**

SRP SECTION: **03.08.03 – Concrete and Steel Internal Structures of Steel or Concrete Containments**

APPLICATION SECTION: **03.08.03**

DATE OF RAI ISSUE: **9/5/2012**

QUESTION NO. RAI 03.08.03-95:

The staff evaluated the applicant's response to RAI 858-6126, Question 03.08.03-49, dated February 28, 2012, regarding the consideration of concrete cracking in the design of APWR CIS structures. Sufficient information was provided regarding the questions raised in the RAI regarding the two stiffness conditions "A" and "B." However, the staff notes that the RAI response indicated that the information provided does not have any impact on the DCD or the technical report. Since this response provided important analysis and design information, revise the technical report to incorporate, and revise the DCD to summarize, the important information provided in the RAI response which has not yet been included in the technical report and DCD.

ANSWER:

MHI concurs with the staff's assessment that the response to RAI 858-6126, Question 03.08.03-49 contains important analysis and design information. Thus the applicable DCD and technical report sections will be revised as stated below.

Impact on DCD

Subsection 3.8.3 will be updated to include the summary given in the RAI 858-6126 Question 03.08.03-49 response concerning the use of both stiffness Conditions 'A' and 'B' in the development of the Containment Internal Structure design load cases and combinations. This summary will also clarify that the Condition 'A' and 'B' analysis results will be enveloped to generate in-structure response spectra as well as member forces for structural design.

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 Reports

Technical Report MUAP-11013 will be revised to incorporate a summary of the procedures described in the response to RAI 858-6126 Question 03.08.03-49 for generating load cases and load combinations using both stiffness conditions, and enveloping the results to generate maximum forces for member design.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/19/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **No. 958-6608**

SRP SECTION: **03.08.03 – Concrete and Steel Internal Structures of Steel or Concrete Containments**

APPLICATION SECTION: **03.08.03**

DATE OF RAI ISSUE: **9/5/2012**

QUESTION NO. RAI 03.08.03-96:

The staff evaluated the applicant's response to RAI 858-6126, Question 03.08.03-50, dated February 28, 2012, regarding the seismic analysis methods used for the US-APWR CIS design, and determined that there were several items in the RAI response that were not addressed. The applicant is requested to provide a description of the models, input loading, analysis procedures, assumptions, including for example the computer code, element types used in computer model, damping, and assumptions on boundary conditions. Also, identify whether the seismic analysis approaches for the response spectrum analysis (RSA) and equivalent static method are consistent with those in SRP 3.7.2 Revision 3 and SRP 3.8.3 Revision 2, or discuss and justify any alternative methods used. The staff notes that the RAI response indicated that the information provided does not have any impact on the DCD nor the technical report. Since this response provided important analysis and design information, revise the technical report to incorporate, and revise the DCD to summarize, the important information provided in the RAI response which has not yet been included in the technical report and DCD.

ANSWER:

All of the requested information regarding the Task 1-B ANSYS model and response spectrum analysis will be presented in a calculation report covering the basic analysis and structural design of the Containment Internal Structure, as described in the current Seismic Closure Plan. More specifically, this calculation report will include detailed description of:

- The ANSYS analysis model and the element types it utilizes,
- The development and input of each of the load cases considered in the basic design (including assumptions such as boundary conditions and damping),
- The analysis procedures used for each load case, and
- The ANSYS input files (computer code) utilized to execute the analysis for each load case.

For the Safe-Shutdown Earthquake (E_{ss}) load case, this description will cover not only the response spectrum analysis procedures employed, but also the live and equipment loads considered as mass in the analysis, accidental torsion, convective and impulsive hydrodynamic loads, and the manner in which the various seismic loading components are combined to generate the total E_{ss} load case.

The Task 1-B response spectrum analysis procedures, as summarized in the response to RAI 858-6126 Question 03.08.03-50, are fully consistent with Regulatory Guide 1.92 Revision 2 and Standard Review Plan (SRP) Section 3.7.2 Revision 3. No alternative analysis methods are used. The response spectrum analysis procedures used are also in accordance with the guidance provided in SRP Section 3.8.3, which refers to Section 3.7.2 for review of seismic analysis procedures (see SRP 3.8.3 Revision 2, subpart 4.A.i).

The equivalent static analysis method will not be used for design of the US-APWR Containment Internal Structure. The equivalent static analysis previously described in Technical Report MUAP-11019 Appendix 4 and in response to RAI Question 03.08.03-50 is no longer required. These documents will be revised to indicate that the Task 1-B response spectrum analysis of the Containment Internal Structure (described above) will also be the seismic analysis of record for design of the primary shield structure. MUAP-11019 Appendix 4 will be revised to present the specific approaches used for 1) extracting the primary shield seismic demands from the response spectrum analysis, and 2) calculating the primary shield structural capacities to be compared with the demands.

Impact on DCD

Subsection 3.7.2 of the DCD will be revised to include a summary of the response spectrum analysis procedures used for design of the US-APWR Containment Internal Structure.

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 Reports

Technical Report MUAP-11013 will be revised to include a summary of the Containment Internal Structure ANSYS model and the analysis methodologies used to calculate seismic demands for structural design.

Appendix 4 of Technical Report MUAP-11019 will also be revised as described in this response.
