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TOKYO, JAPAN

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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-11134

Subject: Revised Completion Plan for US-APWR Seismic and Structural Analyses

- References:** (1) Letter (ML110760142) from Y. Ogata (MHI), K. Yamauchi (MNES), R. Frenzel (Energy Future Holdings), E. Grecheck (Dominion) to U.S. NRC, "Commitments to Improve US-APWR DCD Review Schedule" dated February 18, 2011
- (2) Letter (ML110240150) from D. Matthews (NRC) to Y. Ogata (MHI), "Schedule Change for the United States – Advanced Pressurized Water Reactor Design Certification" dated February 24, 2011

In Reference 1, Mitsubishi Heavy Industries, Ltd. (MHI), with input from MNES, Luminant and Dominion, proposed to the NRC new initiatives that could improve the NRC's draft review schedule of the US-APWR Design Control Document (DCD) and associated technical reports.

In Reference 2, the NRC noted the US-APWR DCD and various supporting technical reports regarding the soil-structure interaction (SSI) analysis did not provide the appropriate level of detail. In addition, Reference 2 reported the NRC staff's review of four technical reports, submitted between February 2010 and April 2010, raised several questions regarding the adequacy of seismic models to reflect the structural response to the dynamic loads, input parameters of the seismic model, and development of floor response spectra and member forces used for the design of structures, systems, and components (SSCs).

To address the critical issues identified by the NRC, the DCWG established task teams. One of these was a seismic task team. On March 31, 2011, the seismic task team presented twelve topics related to remaining NRC staff questions and RAIs of analytical methodologies and results associated with DCD Sections 3.7 and 3.8, including related technical reports. Resolutions for topics presented which require additional information or updates to US-APWR documentation are identified in the deliverables section of the presentation. The twelve topics are the following.

DOB
MRO

1. Seismic Design Basis Models
2. Effect of Concrete Cracking
3. Soil Profiles
4. Structure-Soil-Structure Interaction
5. Water Table effects
6. Embedment Effects on Seismic Response
7. High Frequency Consideration in CSDRS
8. Foundation Analysis
9. Sliding Stability
10. Gap Between Structures
11. Steel Concrete (SC) Modules
12. Steel Liner Plate Strains Near PCCV Penetrations

MHI explained the overall schedule for submittal of impacted technical reports during the US-APWR DCD Chapter 3 Conference Call on April 11, 2011. A listing of technical reports, content changes and submittal dates is shown in Attachment 1. The schedule for calculation reports available for audit is shown in Attachment 2. A listing of impacts on DCD is shown in Attachment 3. DCD mark-ups will be provided with associated technical reports. A complete mark-up will also be submitted to show all DCD seismic changes.

Note that some reports were not discussed at the March 31st public meeting nor the April 11th conference call, but have been included in this letter to ensure the staff is aware of all impacts.

MHI recognizes that the documents for submittal and audit identified in Attachments 1, 2 and 3 are late in the staff's Phase 2 review. The dates proposed have focused on providing methodology documents early, with the results later for confirmation. A public meeting is scheduled for May 19, 2011 to discuss the impacts of the proposed dates included in this letter.

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

Sincerely,



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

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

Contact Information

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Attachment 1 - Submittal Dates of Technical Reports

Doc. #	Title	Current Contents	Updates and Future Contents	Date to NRC
MUAP-10001	Seismic Design Bases of the US-APWR Standard Plant	Rev. 2: - Description of Model for R/B (LMSM) and PS/B (FE model) - Validation of Model for R/B (LMSM) and PS/B (FE model) - Methodology of Concrete Cracking Effects	Rev. 3: - Description of Model for R/B (updated to FE model) and PS/B (update for design changes and stiffness) - Validation of Model for R/B (updated to FE model) and PS/B (update to reflect minor design changes) - Update Methodology of Concrete Cracking Effects (including stiffness reduction, damping values) -Update reference to SASSI to clarify that version 2.3.0 includes module updates through Nov 2009	June 2011
MUAP-10006	Soil-Structure Interaction Analyses and Results for the US-APWR Standard Plant	Rev. 1: - Results of SSI Analysis for R/B (LMSM) and PS/B (FE model)	Rev. 2: - Results of SSI Analysis for R/B (updated to FE model) and PS/B (updated design and stiffness) -Update reference to SASSI to clarify that version 2.3.0 includes module updates through Nov 2009 -Update to reflect gap assessment -Update to reflect results of SSSI analysis report MUAP-11011 if required -Update to include appendix containing parametric study of soil profile for compliance with SRP 3.7.2 -Update to include missing soil properties observed by NRC staff	Oct 2011
MUAP-11001	A/B Model Properties, SSI Analyses, and Structural Integrity Evaluation	Rev. 0: - Description of Model for A/B (FE model) - Results of SSI for A/B	Rev. 1: - Description of Model for A/B (unchanged) - Methodology of Stability and relative displacement for A/B (previously excluded)	June 2011
			Rev. 2: - Results of SSI for A/B relative displacement (change for reduced stiffness) - Results of Stability of A/B (previously excluded) -Update to reflect gap assessment	Sep 2011

MUAP-11002	T/B Model Properties, SSI Analyses, and Structural Integrity Evaluation	Rev. 0: - Description of Model for T/B (FE model) - Results of SSI for T/B	Rev. 1 (potentially required to assess gap): - Description of Model for T/B (unchanged) - Results of SSI for T/B (unchanged) - Update to reflect gap assessment	Sep 2011
MUAP-11006	Validation of LSM for R/B Complex	N/A	Rev. 0: - Description of Model for R/B (LSM) – used only for sliding stability and sensitivity studies - Validation of Model for R/B (LSM)	June 2011
MUAP-11007	Results of Evaluation using LSM for R/B Complex	N/A	Rev. 0: - Methodology of Sliding Stability - Methodology of Sensitivity Study on Water Table Effect - Methodology on Sensitivity Study on Embedment Effect	June 2011
			Rev. 1: - Results of Sensitivity Study on Water Table Effect - Results of Sensitivity Study on Embedment Effect - Results of Sliding Stability	Oct 2011
MUAP-11011	Effects of Structure-Soil-Structure Interaction (SSSI) on Standard Seismic Design of US-APWR Plant	N/A	Rev. 0: - Methodology of SSSI Analysis	June 2011
			Rev. 1: - Results of SSSI Analysis	Oct 2011

MUAP-11013	Design Criteria for SC Modules		- Design Criteria for SC modules - Methodology for SC modules	June 2011
MUAP-08002	PS/B Enhanced Information for PS/B Design	Rev. 0: -Provide results of the lumped mass stick model analysis of east and west PS/Bs	Rev. 1: Superseded by MUAP-10001 and MUAP-10006	N/A
MUAP-08005	Dynamic Analysis of the Coupled RCL-R/B-PCCV-CIS Lumped Mass Stick Model	Rev. 0: -Provide dynamic seismic analysis of the coupled system including the RCL, R/B, PCCV, and CIS. -Frequencies and mode shapes of dominant modes -Acceleration and displacement responses of structures -Forces and moments in selected building structures -ISRS	Rev. 1: Superseded by MUAP-10001 and MUAP-10006	N/A
MUAP-08012	Sump Strainer Stress Report	Rev. 1: - Stress Results based on SSI Analysis for R/B (LMSM)	Rev. 2: - Stress Results based on SSI Analysis for R/B (FEM)	Feb 2012
MUAP-07033	Mechanical Analysis for US-APWR New and Spent Fuel Racks	Rev. 1: - Stress Results based on SSI Analysis for R/B (LMSM)	Rev. 2: - Stress Results based on SSI Analysis for R/B (FEM)	Feb 2012
MUAP-08007	Evaluation Results of US-APWR Fuel System Structural Response to Seismic and LOCA Loads	Rev. 2: - Stress Results based on SSI Analysis for R/B (LMSM)	Rev. 3: - Stress Results based on SSI Analysis for R/B (FEM)	Apr 2012

Attachment 2 - Dates of Calculation Reports (Available for Audit)

Doc. #	Title	Current Contents	Updates and Future Contents	Date to NRC
TBD	New Calculation Report – Documenting PCCV Runs with Reduced and Full Stiffness	N/A	Rev. 0: -Calculation documenting the runs of the PCCV analyses with reduced stiffness (lower bound) SSE damping and full stiffness (upper bound) OBE damping	Sep 2011
TBD	New Calculation Report – Documenting R/B and PS/B Runs with Reduced and Full Stiffness	N/A	Rev. 0: -Calculation documenting the runs of the R/B and PS/B analyses with reduced stiffness (lower bound) SSE damping and full stiffness (upper bound) OBE damping	Sep 2011
TBD	New Calculation Report – Documenting Reduced Stiffness of CIS	N/A	Rev. 0: -Calculation documenting the runs of the CIS analysis with reduced stiffness and associated damping	Sep 2011
TBD	New Calculation Report – Subgrade Modeling in Finite Element Analysis	N/A	Rev. 0: - Demand and allowable bearing pressures - Long term deformation moduli for sand sites and clay sites -Long term displacements for Soil Profile 270-500 considering two types of subgrade –sand and clay - Settlements of all structures including dishing effects and effects of primary consolidation (clay) - Tilt of all structures from long term loads for gap - Differential settlements from long term loads (between adjacent structures and for each structure) - Revised Calculation Report will be available for audit	Aug 2011

TBD	New Calculation Report – Dynamic Differential Displacement	N/A	Rev. 0: -Dynamic Differential Displacements methodology and results	Aug 2011
TBD	New Calculation Report – Submodeling for Strain Near PCCV Penetrations	N/A	Rev. 0: -Detailed calculation of strain results near all penetrations	Aug 2011
TBD	Design Report for the Basic design of the US-APWR PCCV	N/A	Rev. 0: - Basic Design Results based on the seismic design forces obtained by FEM	January 2012
TBD	Design Report for the Basic Design of the US-APWR CIS	Rev. 0: - Basic Design Results based on the seismic design forces obtained by LMSM	Rev. 1: - Basic Design Results based on the seismic design forces obtained by FEM	January 2012
TBD	Design Report for the Basic Design of the US-APWR R/ B	Rev. 0: - Basic Design Results based on the seismic design forces obtained by LMSM	Rev. 1: - Basic Design Results based on the seismic design forces obtained by FEM	January 2012
TBD	Design Report for the Basic Design of the US-APWR R/B Foundation	Rev. 0: - Basic Design Results based on the seismic design forces obtained by LMSM	Rev. 1: - Basic Design Results based on the seismic design forces obtained by FEM	January 2012
TBD	Design Report for the Basic Design of the US-APWR PS/B	Rev. 0: - Basic Design Results based on the seismic design forces obtained by FEM	Rev. 1: - Basic Design Results incorporated in the revision of MUAP-10006	January 2012

Attachment 3 – Impacts on DCD

DCD Affected Sections	Summary of change
Table 2.0-1	Revise the soil profiles description and data Revise bearing capacity demands. Revise allowable settlements
3.5, 3.7 (General)	Update for latest ACI 349 revision including any criteria updates
3.7.1.2	Update this discussion to tie to the bounding conditions discussion in 3.7.2.3.1 with respect to how proper damping values are selected
3.7.2	Revise methodology for seismic response analyses of R/B Complex and PS/B dynamic FE models
3.7.2.1	Revise discussion of seismic analysis methods to reflect latest methods, especially table 3.7.2-1
3.7.2.2	Update natural frequencies and responses discussion based on the latest results and import some basic results information from MUAP-10001 and/or MUAP-10006 Update with any needed references to A/B and T/B reports and/or results (general note and may apply to other sections)
3.7.2.3.1	Update analytical models discussion particularly regarding bounding conditions analyses and how damping values are assigned in conjunction with the various bounding/stiffness conditions (cracked, uncracked)
3.7.2.3.2	Revise discussion due to changing from lumped mass stick model design basis to dynamic FE model design basis
3.7.2.3.5, 3.7.2.3.6, 3.7.2.3.7, 3.7.2.3.8, 3.7.2.3.9	Revise/delete as necessary to explain switch from lumped mass stick models
3.7.2.3.10	Rewrite to address how the dynamic FE models for R/B complex are validated
3.7.2.4	Revise to address how the standard design envelopes/considers possible embedment effects
3.7.2.8	Update section for gap discussion as necessary based on new gap criteria (size of gap, etc) Update section for any SSSI discussion, results, methodology, etc along with any new tables and figures and any needed changes to COL 3.7(10) regarding SSSI analyses requirements Update with any needed references to A/B and T/B seismic reports and results
3.7.3 (general)	Update for any changes to high-frequency subsystem analyses
3.7 Figures and Tables (General)	Revise tables and drawings as applicable to reflect design changes

3.8.1 (General)	Update figures/discussion to add transient pressure conditions to the same level of detail as the figures for transient temperature
3.8.1.4.1.2	Update to address latest methodology for PCCV thermal analyses
3.8.1.4.2	Update to address latest PCCV concrete considerations methodology
3.8.1.4.3	Update discussion of ultimate capacity of PCCV based on latest analyses of liner stress and strain at penetrations
3.8.1.4.4	Update PCCV liner system design and analysis discussion with regard to post-processing discussion, investigation of local strains and stresses at penetrations, tolerances considered in the design evaluation, etc. Update or add associated tables and figures.
3.8.3 (General)	Revise the design criteria and methodology of SC
3.8.3.4 & 3.8.3.4.1	Update discussion of design and analysis procedures for SC modules and associated tables and figures
3.8.3.4.3	Update SC module thermal analyses discussions and explanations
3.8.3.4.4	Update design procedures particularly with regard to statements about the ACI 349 strength method
3.8.3.5.2	Update for critical SC wall sections along with associated figures and tables
3.8.4 (General)	Update for latest ACI 349 code edition
3.8.4.1	Revise acceptance criteria for superstructure gap as required to reflect calculation
3.8.4.1.3	Revise descriptions of shear keys for Cat I Structures as applicable to reflect design changes
3.8.4.1.3	Provide description of methodology used for stability evaluations.
3.8.4.4.1.1	Update for critical sections along with any figures and tables
3.8.4.4.2.1	Update for critical sections along with any figures and tables
3.8.5 (general)	Update for latest ACI 349 code edition
3.8.5.1	Update gap statements as required.

3.8.5.5.2	Update section as necessary for sliding stability criteria
3.8.5.4.1	Expand discussion of how effects of frequency dependence are properly captured. Update bearing capacity and bearing demands discussion. Update embedment effects discussion.
3.8.5.4.2	Update discussion. Springs are not used. 100-40-40 is not used.
3.8.5.4.2.1	Consider updating the basemat modeling discussion based on most recent basemat analyses.
3.8.5.4.4	Revise analyses of settlement and bearing capacity discussion as required to reflect latest methodology
3.8.6	Update COL 3.8(22) to include tilt and related conditions. Update COL 3.8(25) and 3.8(26) due to updated settlement criteria and to tie better to updated criteria in Table 2.0-1.
3.8 Tables and Figures (General)	Revise tables and drawings as applicable to reflect design and methodology changes
Appendix 3H	Describe and provide properties of the R/B complex and PS/B Dynamic FE models. Update description and properties of RCL lumped mass stick model.
Appendix 3I	Revise R/B Complex In-Structure Response Spectra (ISRS) and provide ISRS for PS/B
Appendix 3J	Revise wall thickness to reflect changes to the R/B, PS/B and CIS required to reflect analysis in FE model
19.1.5.1.1	Revise soil cases in Seismic Risk Evaluation