

**REQUEST FOR ADDITIONAL INFORMATION 216-1749 REVISION 01**

2/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 03.10 - Seismic and Dynamic Qualification of Mechanical and Electrical Equipment  
Application Section: 3.10 Seismic Qualification of Mechanical and Electrical Equipment

QUESTIONS for Engineering Mechanics Branch 1 (AP1000/EPR Projects) (EMB1)

03.10-1

RAI USAPWR-3.10-1

DCD in Tier 2, Section 3.10.2 uses the recommended guidance and requirements given in IEEE Standard 344-1987 and RG 1.100 for the development and implementation of methods and procedures for seismic qualification of mechanical and electrical equipment. The methods and guidance in ASME QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants", including Appendix QR-A with exceptions to be provided in a future revision of RG 1.100, are also used; and in Section 3.10.4, the DCD addresses the requirements of GDC 1 and 10 CFR 50, Appendix B, Criteria XVII to establish records concerning the qualification of equipment, and maintaining their qualification files. These files describe the qualification method used for equipment and the tests and analyses results in sufficient detail to document the degree of compliance with the equipment seismic qualification requirements.

In accordance with Section C.I.3.10.4 of RG 1.206, it is stated that, if the seismic and dynamic qualification testing is incomplete at the time of application, the applicant should include an implementation program, including milestones and completion dates with appropriate information submitted for staff review and approval prior to installation of equipment. Therefore, the applicant is requested to provide information as described above for the staff's review and approval. (COL Action Items 3.10 (1) and 3.10 (3) may not be adequate to take care of this issue because COL applicant is not responsible for the US-APWR equipment).

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03.10-2

RAI US-APWR-3.10-2

In Section 3.10-2 of US-APWR DCD, the applicant discussed briefly the equipment seismic issues related to hard rock high frequency (HRHF) seismic excitation. However, the criteria and procedures used for addressing the HRHF issues in DCD are not consistent with the staff guidance (ISG on Seismic Issues Associated with the High Frequency Ground Motion in Design Certification and Combined License Applications). In particular, the use of sine beat at 1/3 octave for screening test, and the statement that

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“the above testing is not a qualification test” are not acceptable. Sine beat at 1/6 octave should be used for screening test, and for screened-in equipment and/or components (equipment potentially sensitive to high frequency excitation), the test procedure is to be consistent with the requirements of IEEE 344 as supplemented by NRC RG 1.100 (i.e. 5 OBEs and one SSE), to meet the NRC regulations, Appendix A to 10 CFR Part 100 and Appendix S to 10 CFR 50, and the criterion and procedure delineated in SECY-93-087.

Therefore, the applicant is requested to provide detailed criteria and procedure to address the HRHF issues in accordance with the staff’s guidance ISG for staff review and approval.

### 03.10-3

RAI USAPWR-3.10-3

DCD Tier 2, Section 3.10.2 States:

With the elimination of the OBE from design considerations, two alternatives exist that essentially maintain the requirements provided in IEEE Std 344-1987 to qualify equipment with the equivalent of five OBE events followed by one SSE event (with ten maximum stress cycles per event). Of these alternatives, the equipment is qualified with five 1/2 SSE events followed by one full SSE event (with ten maximum stress cycles per event). In terms of maximum stress cycles for fatigue analysis, in accordance with SECY-93-087, this is equivalent to any of the following:

- 20 cycles of SSE,
- 50 cycles of 1/2 SSE and 10 cycles of SSE,
- 150 cycles of 1/3 SSE and 10 cycles of SSE,
- 300 cycles of 1/3 SSE
- 100 cycles of 1/2 SSE

The applicant’s interpretation of SECY-93-087 related to seismic qualification of US-APWR mechanical and electrical equipment is not entirely correct. The last two bullets are not acceptable because there is no SSE level qualification involved. The applicant is requested to correct this interpretation in the DCD.

### 03.10-4

RAI USAPWR-3.10-4

DCD Tier 2, Section 3.10.2, Under Testing, the following statements appeared on Page 3.10-7 and page 3.10-11:

“The TRS envelopes the RRS except for equipment not sensitive to high frequency motion with exceedances in the 25-50 Hz range.”

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"...the TRS is shown to envelope the RRS over the entire frequency range of interest, except for equipment not sensitive to high frequency motion with exceedances in the 25-50 Hz range."

SRP 3.10, Acceptance Criteria, requires that for seismic and dynamic loads, the actual test input motion should be characterized in the same manner as the required input motion, and the conservatism in amplitude and frequency content should be demonstrated (i.e., the test response spectrum (TRS) should closely resemble and envelop the required response spectrum (RRS) over the frequency critical range).

Therefore, the applicant is requested to justify that the US-APWR mechanical and electrical equipment seismic qualification (including HF excitations) meets the SRP Section 3.10 acceptance criteria and SECY 93-087.

03.10-5

RAI USAPWR-3.10-5

DCD Tier 2, Section 3.10.2:

- a) In Section 3.10.2.1.1, Type Testing, the applicant uses IEEE Standard 382-1996, "IEEE Standard for Qualification of Actuators for Power-operated Valve Assemblies with Safety-Related Functions for Nuclear Power Plants," for qualification of line mounted equipment. It is noted that the testing frequency range used in IEEE 382-1996 may not be adequate for US-APWR equipment. The applicant is requested to identify all components that are being addressed using IEEE Standard 382-1996, and justify adequacy.
- b) In Subsection 3.10.2.2, a rigid valve is defined as the valve with a natural frequency equal to or exceed 33 hertz. Figure 6 of IEEE 382-1996 is used as the RIM (up to 32 Hz) for qualification of valve. The definition of rigid valve, the determination of the equivalent static load from the dynamic analysis of the valve, and the use of Figure 6 of IEEE standard might not be adequate for the HRHF required response spectra (RRS) with exceedance. For HRHF spectra, the definition of rigid valve depends on the frequency at the beginning of zero period acceleration (ZPA) of the RRS for the valve. The applicant is requested to explain why the use of Figure 6 (frequency ends at 32 Hz) of IEEE 382-1996 is still adequate for qualification of valves, and provide methodologies that would be acceptable for the case of HRHF RRS with exceedance.

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03.10-6

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In Tier 2, Section 3.10.2.2, under "Valves," the applicant is requested to correct the following inconsistency in the use of ASME QME-1 (Reference 3.10-12):

On page 3.10-4, DCD refers to ASME QME-1-2002 (Reference 3.10-12), on page 3.10-12, DCD refers to ASME QME-1-2007 (Reference 3.10-12), and on page 3.10-20, DCD refers to ASME-QME-1-2002. However, the reference in DCD statement should be "ASME QME-1-2007."

03.10-7

RAI USAPWR-3.10-7

In Section 3.10.1.3, Performance Criteria, of the US-APWR DCD, the applicant's statement that the deformation of component supports and structures is acceptable at the SSE levels requires justification.

The applicant is requested to provide additional information and to revise Section 3.10 of the DCD to explicitly clarify and justify the level, and location/situations, of deformation that will be allowable according to the proposed approaches for seismic qualification testing and/or analysis by specifying the permissible extent and degree of inelasticity at the SSE design level for the various categories of equipment (and types of equipment supports), the criteria (or reference state) for successful performance of the equipment safety function during seismic qualification (to at least 10 percent beyond the RRS level), and the applicant's basis (whether implicit or explicit) for assuring adequate beyond-design-basis margin with respect to both inelastic capacity reserve and equipment functionality reserve.

03.10-8

RAI USAPWR-3.10-8

In 6<sup>th</sup> Paragraph on Page 3.10-8, DCD states that for components that have been previously tested to IEEE Standard 344-1971, the COL applicant is to re-qualify the components using biaxial test input motion unless the applicant provides justification for using a single-axis input motion.

This process may not be adequate because the adequacy of seismic qualification of US-APWR equipment within the DCD scope should be addressed and approved within the DCD review and the COL Action Item 3.10(5) may not be acceptable. Therefore, the applicant is requested to clarify this statement.

03.10-9

RAI USAPWR-3.10-9

In Section 6, Seismic Analysis, of the December 2007 Mitsubishi Report, MUAP-07024-P (R0), "Qualification and Test Plan of Class 1E Gas Turbine Generator (GTG) System,"

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the seismic analysis includes the power section (Gas Turbine Engine Assembly), and the Reduction Gearbox.

The seismic capability of the GP6000-type Gas Turbine (including the power section and Reduction Gearbox) was evaluated using 1g shock loads in the axial and radial directions of the shaft. However, shock loading tests are not the same as the loading subject to the RRS input motions at the GTG system location.

The applicant is requested to provide adequate detail of the seismic qualification of Class 1E GTG system in accordance with the criteria and procedures delineated in DCD Section 3.10.2.