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March 25, 2009

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-09115

Subject: MHI's Response to US-APWR DCD RAI No. 216-1749

Reference: 1) "Request for Additional Information No. 216-1749 Revision 1, SRP Section: 03.10 – Seismic and Dynamic Qualification of Mechanical and Electrical Equipment, Application Section: 3.10 Seismic Qualification of Mechanical and Electrical Equipment," dated 2/26/2009.

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. 216-1749, Revision 1."

Enclosed are the responses to 5 RAIs contained within Reference 1. Of these RAIs in Reference 1, 4 will not be answered within this package. They are:

RAI USAPWR-3.10-3, which has a 60-day response time, as agreed to between the NRC and MHI, and will be issued at a later date by a separate transmittal.

RAI USAPWR-3.10-5, which has a 60-day response time, as agreed to between the NRC and MHI, and will be issued at a later date by a separate transmittal.

RAI USAPWR-3.10-7, which has a 60-day response time, as agreed to between the NRC and MHI, and will be issued at a later date by a separate transmittal.

RAI USAPWR-3.10-9, which has a 60-day response time, as agreed to between the NRC and MHI, and will be issued at a later date by a separate transmittal.

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.

Sincerely,

Y. Ogata

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

D081
NRO

Enclosure:

1. Response to Request for Additional Information No. 216-1749, Revision 1

CC: J. A. Ciocco
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Docket No. 52-021
MHI Ref: UAP-HF-09115

Enclosure 1

UAP-HF-09115
Docket No. 52-021

Response to Request for Additional Information No. 216-1749,
Revision 1

March, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/25/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **NO. 216-1749 REVISION 01**

SRP SECTION: **03.10 – Seismic and Dynamic Qualification of Mechanical and Electrical Equipment**

APPLICATION SECTION: **3.10**

DATE OF RAI ISSUE: **02/26/09**

QUESTION NO. 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).

ANSWER:

MHI recognizes the seismic and dynamic qualification testing will be incomplete at the time of application. Therefore, an implementation program, including milestones and completion dates with appropriate information, will be submitted for staff review and approval prior to installation of equipment as part of the US-APWR Equipment Environmental Qualification (EQ) Program. DCD COL Item 3.10(1) indicates that it is the COL Applicant's responsibility to implement the US-APWR Equipment EQ Program, and to provide milestones and completion dates for its implementation. An explanation is provided as follows.

Procurement activities and the associated seismic and dynamic qualification testing for both US-APWR standard plant and project-specific equipment are not complete at the time of the DC

application. MHI Technical Report MUAP-08015(R0) has recently established and defined the generic US-APWR Equipment Environmental Qualification Program. The MHI Technical Report MUAP-08015(R0) supplements the US-APWR DCD and includes testing requirements and criteria for qualification of standard plant and site-specific electrical and instrumentation equipment, mechanical equipment, and inline fluid system components. Implementation of the EQ Program is dependent upon the unique schedule for each US-APWR plant site, including procurement activities and associated qualification testing. Although the COL Applicant is not responsible for the design of the US-APWR standard plant equipment, the COL Applicant is responsible for project-specific implementation of the US-APWR Equipment EQ Program. This includes but is not limited to procurement and associated testing of both standard and project-specific equipment, and associated documentation. Implementation also includes development and maintenance of equipment qualification files. Therefore, it is the COL Applicant's responsibility to ensure that equipment is qualified as applicable for seismic and dynamic loadings according to the criteria and requirements of the equipment qualification program described within the Equipment EQ Program, and to provide implementation milestones and completion dates with appropriate information for NRC staff's review and approval.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **NO. 216-1749 REVISION 01**

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APPLICATION SECTION: **3.10**

DATE OF RAI ISSUE: **02/26/09**

QUESTION NO. 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 "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.

ANSWER:

The MHI US-APWR EQ Program supplements the US-APWR DCD. To be consistent with current requirements, including that of the MHI US-APWR EQ Program, DCD Tier 2 Section 3.10.2 will be revised to change the sine beat octave to 1/6 for the screening tests. The screening tests described in Section 3.10.2 are not intended to be qualification tests but instead are intended to determine if equipment is potentially sensitive to high-frequency excitation. If the screening tests determine that the equipment is potentially sensitive to high-frequency excitation ("screened-in"), then full-scale qualification testing including testing over the range of high-frequency exceedances is required. The statement in the DCD that "the above testing is not a qualification test" will be modified to clarify this point.

Detailed criteria and procedures to address to HRHF issues in accordance with USNRC "Interim Staff Guidance on Seismic Issues Associated with High Frequency Ground Motion in Design Certification and Combined License Applications" (May 2008) are provided in the MHI US-APWR EQ Program. The qualification criteria, documented in the procedure, incorporate the

requirements of and are consistent with IEEE 344, RG 1.100, SECY-93-087, and USNRC DG-1175.

Impact on DCD

See Attachment 1 for a mark-up of DCD Tier 2, Section 3.10, Revision 2, changes to be incorporated.

- Change the eighth paragraph of Subsection 3.10.2 to:

  "If existing test data are not available and a system and control logic review indicates that inadvertent change of state or intermediacy must be considered, then one of the following high frequency screening tests are used to demonstrate lack of sensitivity to high frequency vibrations in the 25-50 Hz range where the function is monitored during the screening test as followed by post test functional testing: sine sweep (fast linear rate, traditional log rate); sine beat at 1/6 octave spacing; band-limited white noise; or, random multifrequency time history."

- Change the ninth paragraph of Subsection 3.10.2 to:

  "The above testing is not a qualification test but is intended to determine if equipment is potentially sensitive to high-frequency excitation. If the screening tests determine that equipment is potentially sensitive to high-frequency excitation ("screened-in"), then full-scale qualification testing including testing over the range of high-frequency exceedances is required to assure that unacceptable components are not present in the set of qualified equipment and functional systems."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/25/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 216-1749 REVISION 01**
SRP SECTION:	**03.10 – Seismic and Dynamic Qualification of Mechanical and Electrical Equipment**
APPLICATION SECTION:	**3.10**
DATE OF RAI ISSUE:	**02/26/09**

QUESTION NO. 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."

"...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.

ANSWER:

With limited exceptions such as the one discussed in this response, the US-APWR EQ Program requires that the actual test input motion be characterized in the same manner as the required input motion, and that conservatism in amplitude and frequency content are demonstrated [i.e., the test response spectrum (TRS) should closely resemble and envelop the required response spectrum (RRS) over the critical range of frequencies]. The DCD statements quoted in the question above are intended to indicate the exception that it would not be required for the TRS to envelope the RRS in the high frequency range if the "critical frequency range" for the equipment/components does not include frequencies within the high frequency range. The "critical frequency range" of equipment/components, as referred to in SRP 3.10, is established by testing (either screening tests or qualification tests). This exception applies to equipment/

components for which the measured resonance frequencies are outside the high frequency exceedance range.

The test input motion requirements for equipment qualification, including enveloping requirements for the TRS with regard to the RRS, are described in detail in MHI US-APWR EQ Program procedures. The procedural requirements are intended to be in accordance with the acceptance criteria in SRP Section 3.10, SECY 93-087, and also IEEE 344, IEEE 323, RG 1.100, and DG-1175.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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APPLICATION SECTION: **3.10**

DATE OF RAI ISSUE: **02/26/09**

QUESTION NO. RAI USAPWR-3.10-6:

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."

ANSWER:

DCD Section 3.10.2 reference of ASME QME-1-2002 and DCD Section 3.10.6 will be corrected in Revision 2 to incorporate the proper reference of ASME QME-1-2007.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.10, Revision 2, changes to be incorporated.

- Change the second sentence of the first paragraph in Subsection 3.10.2 to: "The methods and guidance in "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants", ASME QME-1-2007 (Reference 3.10-12), including Appendix QR-A with exceptions to be provided in a future revision of RG 1.100 (Reference 3.10-7), are also used for seismic qualification of active mechanical equipment."

- Change Reference 3.10-12 in Subsection 3.10.6 to:

  "3.10-12 Qualification of Active Mechanical Equipment Used in Nuclear Power Plants. American Society of Mechanical Engineers (ASME) QME-1-2007."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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APPLICATION SECTION: **3.10**

DATE OF RAI ISSUE: **02/26/09**

QUESTION NO. RAI USAPWR-3.10-8:

In 6th 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.

ANSWER:

The DCD paragraph referenced in the question above will be clarified to state that guidelines for qualifying components with respect to single-axis and biaxial test input motion are included in the procedures of the US-APWR Equipment Environmental Qualification Program. An explanation is provided as follows.

Procurement activities and the associated seismic and dynamic qualification testing for both US-APWR standard plant and project-specific equipment are not complete at the time of the DC application. MHI Technical Report MUAP-08015(R0) has recently established and defined the generic US-APWR Equipment Environmental Qualification (EQ) Program. The US-APWR EQ Program supplements the US-APWR DCD and includes testing requirements and criteria for qualification of standard plant and site-specific electrical and instrumentation equipment, mechanical equipment, and inline fluid system components. The EQ Program criteria define specific conditions for when single-axis input motion can be justified and also define requirements for biaxial test input motion. Since procurement of equipment does not occur under the scope of the DC application, it is therefore the COL Applicant's responsibility to ensure that any equipment previously tested to IEEE Standard 344-1971 is re-qualified as necessary according to the criteria in the MHI US-APWR EQ Program.

Impact on DCD

See Attachment 1 for a mark-up of DCD Tier 2, Section 3.10, Revision 2, changes to be incorporated.

- Add as last sentence in the seventh paragraph under "**Testing**" of Subsection 3.10.2:

  "Guidelines for qualifying components are included in the procedures of the US-APWR Equipment Environmental Qualification Program (Reference 3.11-3).

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

This completes MHI's responses to the NRC's questions.

are provided in the corresponding EQSDSs. An EQSDS is developed for every item of instrumentation and electrical equipment classified as seismic category I. Section 3.11 and Appendix 3D provides the environmental conditions of the electrical equipment, including the environmental conditions associated with normal operations, maintenance, testing, and postulated accidents, to be demonstrated before, during and after a seismic event. The equipment qualification file and EQSDS identify the test response spectrum (TRS) and the Required Response Spectra (RRS) for the seismic qualification. The TRS is required to envelope the RRS for qualification of equipment.

The performance requirements for seismic category I active mechanical components are defined in the corresponding equipment specifications along with the system functional requirements as described in Section 3.2, Section 3.9, and in the sections describing the various systems. Subsection 3.10.2.2 and Section 3.9 discuss additional requirements for active pumps, valves, and dampers and these requirements are included in the EQSDSs contained in the equipment qualification file. For other seismic category I mechanical components, the performance requirements are to maintain structural integrity under seismic and other concurrent applicable loading conditions. The demonstration of meeting the performance requirements is included in the EQSDSs for each mechanical component.

3.10.1.3 Performance Criteria

The qualification of safety-related components to safely withstand seismic loadings in combination with other concurrent dynamic loading effects demonstrates that safety-related seismic category I instrumentation and electrical equipment, and mechanical equipment, including active pumps, valves and dampers, are capable of performing their designated safety-related function(s) under the postulated SSE, as defined in Subsection 3.7.1, in combination with other concurrent loadings. Deformation of supports and structures is acceptable at the SSE levels, provided that their designated safety-related functional performance is not compromised and does not compromise the safety-related function of other equipment.

3.10.2 Methods and Procedures for Qualifying Mechanical and Electrical Equipment and Instrumentation

The recommended guidance and requirements in IEEE Std 344-1987 (Reference 3.10-6) and RG 1.100 (Reference 3.10-7) are used for the development and implementation of methods and procedures for seismic qualification of mechanical and electrical equipment. The methods and guidance in "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants", ASME QME-1-200~~2~~7 (Reference 3.10-12), including Appendix QR-A with exceptions to be provided in a future revision of RG 1.100 (Reference 3.10-7), are also used for seismic qualification of active mechanical equipment.

The US-APWR seismic category I active mechanical and electrical equipment are seismically qualified in accordance with IEEE standards to safely withstand the SSE effects in combination with other applicable dynamic and static loads.

The design limits, load combinations associated with normal operations, postulated accident, and specified seismic and other transient events, and methods for combining dynamic responses for mechanical equipment are described in Subsection 3.9.3. The dynamic loads considered in testing of instrumentation and electrical equipment, are

seismic loads, hydrodynamic, and vibratory loads, as applicable, as discussed in Section 3.11.

Recent seismic research, including recently published attenuation relations, indicates that earthquakes in the central and eastern United States have more energy content in the high-frequency range than earthquakes in the western United States. Therefore, the COL Applicant is to investigate if site-specific in-structure response spectra generated for the COL application may exceed the standard US-APWR design's in-structure response spectra in the high-frequency range. Accordingly, the COL Applicant is to consider the functional performance of vibration-sensitive components, such as relays and other instrument and control devices whose output could be affected by high frequency excitation.

The potential failure modes of the high frequency-sensitive component types and assemblies are considered in order to demonstrate the suitability of the equipment for high-frequency seismic environments. The generic failure modes involving inadvertent change of state, contact chatter, signal change/drift, and connection problems due to high frequency effects are the main focus of the high frequency qualification testing. High frequency failures resulting from improper design of mounting, inadequate design connections and fasteners, mechanical misalignment/binding of parts and the rare case of failure of a component part, will result from the same structural failure modes as those experienced during low frequency content spectra qualification testing in accordance with IEEE Std 344-1987 (Reference 3.10-6). Because the safety-related equipment will experience higher stresses and deformations when subjected to the low frequency excitation, these failure modes are more likely to occur under the low frequency testing. Failure modes related to improper mounting, inadequate securing of connections, poor quality joints (cyclic strain effects), etc., are precluded by quality assurance inspection and process/design controls.

Potentially high frequency sensitive components include: electro-mechanical relays; electro-mechanical contactors; circuit breakers; auxiliary contacts; control switches; transfer switches; process switches and sensors; potentiometers; and digital/solid-state devices (mounting and connections only).

Acceptable methods for resolving high frequency concerns not already addressed by certified design qualification where site-specific in-structure response spectra generated for the COL application results in high frequency exceedances of the standard design in-structure response spectra include: review existing equipment qualification test data for adequate high frequency input motion; review circuits containing potentially sensitive items for inappropriate system actions due to intermediacy or set point drifts; or screening test to confirm equipment does not have high frequency vulnerabilities.

If existing test data are not available and a system and control logic review indicates that inadvertent change of state or intermediacy must be considered, then one of the following high frequency screening tests are used to demonstrate lack of sensitivity to high frequency vibrations in the 25-50 Hz range where the function is monitored during the screening test followed by post test functional testing: sine sweep (fast linear rate, traditional log rate); sine beat at ~~1/3~~ 1/6 octave spacing; band-limited white noise; or, random multifrequency time history.

The above testing is not a qualification test but is intended to determine if equipment is potentially sensitive to high-frequency excitation. If the screening tests determine that

equipment is potentially sensitive to high-frequency excitation ("screened-in"), then full-scale qualification testing including testing over the range of high-frequency exceedances is required to assure that ~~high frequency sensitive~~ unacceptable components are not present in the set of qualified certified design equipment and functional systems.

In conjunction with the above, for the purpose of qualification of equipment by analysis, the rigid range is defined as having a natural frequency greater than 50 Hz. For the purpose of testing equipment that is not sensitive to response levels caused by high frequency ground motions, rigid is defined as equipment with a natural frequency greater than 33 Hz. If the equipment, to be tested, is sensitive to response caused by high frequency ground motions, then rigid is defined as equipment having a natural frequency greater than 50 Hz.

The US-APWR utilizes the following methods for seismic qualification of equipment based on the type, size, shape, and complexity of the equipment configuration, whether the safety function can be assessed in terms of operability or structural integrity alone, and the reliability of the conclusions:

- Predict the equipment's performance by analysis
- Test the equipment under simulated seismic conditions
- Qualify the equipment by a combination of test and analysis

The US-APWR seismic category I equipment is qualified to show that it can perform its safety-related function during and after a postulated earthquake. The seismic qualification considers interfaces and the effects of the amplification within the equipment due to the interfaces and supporting structure. The function of the equipment is dependent on the equipment itself and the system in which it is to function. The safety-related function is determined as that required both during and after a postulated earthquake, which could be different. For example, an electrical device may be required to have no spurious operations during the postulated earthquake or to perform an active function both during, and after, the postulated earthquake, or it may be required to survive during the postulated earthquake and perform an active function after the postulated earthquake, or any combination of these. Another device may only be required to maintain structural integrity during and after the postulated earthquake.

The functionality of mechanical and electrical equipment during and after a postulated earthquake of magnitude up to and including the SSE for static and dynamic loads from normal, Anticipated Operational Occurrence and accident load conditions is assured by tests and/or analyses. The horizontal and vertical SSE RRS curves developed at the damping of interest, as discussed in Subsections 3.7.1 and 3.7.3, form the basis for the seismic qualification of the equipment. The equipment is demonstrated to withstand the equivalent effect of five OBE excitations followed by one SSE for qualification without loss of structural integrity and functionality, as required.

With the elimination of the OBE from design considerations, two alternatives exist that essentially maintain the requirements provided in IEEE Std 344-1987 (Reference 3.10-6) to qualify equipment with the equivalent of five OBE events followed by one SSE event

of the postulated earthquakes, and whether the equipment is to be used in one application or many (proof testing or generic testing). Equipment is conservatively tested considering the multidirectional effects of the postulated earthquakes.

The types of test to be used are single frequency and multifrequency. The seismic and dynamic test inputs are provided by the in-structure floor response spectra identified with the building elevation derived from the SSE and developed by the time-history modal analysis method or direct integration method for various damping values as described in Subsection 3.7.3.

Multi-frequency testing provides a broadband test motion that is appropriate for producing a simultaneous response from modes of a multi-degree-of-freedom system whose malfunction may be caused by modal interaction. Multi-frequency testing is the preferred method since the seismic and dynamic load excitation generally has broad frequency content.

Single-frequency testing, such as sine beats, is used when the seismic ground motion is filtered due to one predominant structural mode; when the resulting floor motion may consist of one predominant frequency; when it can be demonstrated that the anticipated response of the equipment is adequately represented by one mode; or, when the input has sufficient intensity and duration to excite the relevant modes to the required magnitude, such that the TRS envelopes the corresponding spectra.

For the seismic and dynamic portion of the loads, the test input motions are applied to one vertical axis and one principal horizontal axis (or two orthogonal horizontal axes) simultaneously, unless it is demonstrated that the equipment response is not sensitive to the vibratory motion in the horizontal direction, and vice versa. The time phasing of the inputs in the vertical and horizontal directions must be such that a purely rectilinear resultant input is avoided. An alternate method is to test with the vertical and horizontal inputs in-phase, and then repeat the test with inputs 180 degrees out-of-phase. This type of testing must be repeated with the equipment rotated 90 degrees horizontally.

Components that have been previously tested to IEEE Std 344-1971 prior to submittal of the DCD are reevaluated to justify the appropriateness of the input motion and requalify the equipment, if necessary. The COL Applicant is to requalify the component using biaxial test input motion unless the applicant provides justification for using a single-axis test input motion. Guidelines for qualifying components are included in the procedures of the US-APWR Equipment Environmental Qualification Program (Reference 3.11-3).

The equipment to be tested is mounted in a manner that simulates the intended service mounting, and the fixture design is such that it does not cause any extraneous dynamic coupling to the test component.

The dynamic coupling effect of electrical connections, conduit, sensing lines, and any other interfaces are considered and included in the test unless otherwise justified. The method chosen for testing depends upon the nature of the expected vibration environment and also on the nature of the equipment.

Seismic testing is performed in the proper sequence as indicated in "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations", IEEE Std 323-1974 (Reference 3.10-15) and the testing identifies and accounts for significant

3.10-2 General Design Criteria for Nuclear Power Plants, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix A, U.S. Nuclear Regulatory Commission, Washington, DC.

3.10-3 Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix B.

3.10-4 Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs. SECY-93-087, United States Regulatory Commission, April 2, 1993.

3.10-5 Earthquake Engineering Criteria for Nuclear Power Plants, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix S, U.S. Nuclear Regulatory Commission, Washington, DC.

3.10-6 IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) Std 344-1987.

3.10-7 Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants. Regulatory Guide, 1.100, Rev. 2, U.S. Nuclear Regulatory Commission, Washington, DC, June 1988.

3.10-8 IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations. Institute of Electrical and Electronics Engineers (IEEE) Std 344 -2004.

3.10-9 Seismic and Dynamic Qualification of Mechanical and Electrical Equipment. NUREG-0800, Standard Review Plan 3.10, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.10-10 Boiler and Pressure Vessel Code. "Section III, Division 1, Nuclear Power Plant Components," American Society of Mechanical Engineers.

3.10-11 Functional Specification for Active Valve Assemblies in Systems Important to Safety in Nuclear Power Plants. Regulatory Guide 1.148, U.S. Nuclear Regulatory Commission, Washington, DC, March 1981.

3.10-12 Qualification of Active Mechanical Equipment Used in Nuclear Power Plants. American Society of Mechanical Engineers (ASME) QME-1-2002~~7~~.

3.10-13 Damping Values for Seismic Design of Nuclear Power Plants. Regulatory Guide 1.61, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.10-14 Guidance for Seismic Qualifications of Class 1 Electric Equipment for Nuclear Power Generating Stations. Institute of Electrical and Electronics Engineers (IEEE) Std 344-1971.