REQUEST FOR ADDITIONAL INFORMATION 901-6257 REVISION 3

2/14/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 03.11 - Environmental Qualification of Mechanical and Electrical Equipment
Application Section: 3.11

QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects) (CIB1)

03.11-48

The staff approved methodology for qualification of mechanical equipment is ASME QME-1-2007 as endorsed by Regulatory Guide 1.100, Revision 3. When a licensee commits to use ASME QME-1-2007 for its qualification of mechanical equipment, then the criteria and procedures delineated in ASME QME-1-2007 become part of the requirements for its qualification program. Likewise, when a licensee commits to use non-mandatory appendices in ASME QME-1-2007 for its qualification of mechanical equipment, then the criteria and procedures delineated in those non-mandatory appendices become part of the requirements for its qualification program. However, several sections of Technical Report MUAP-08015 states that QME-1-2007 provides guidance for qualification of mechanical equipment. The licensee is requested to revise the following sections of MUAP-08015(R1) to clarify when ASME QME-1-2007 is required for its qualification program.

(1) In MUAP-08015, Section 3.3, “NRC Regulatory Guides,” the paragraph titled RG 1.100 Revision 3 states “QME-1 provides additional guidance on the qualification of mechanical active components such as valves, pumps and non-metallics.” The staff suggests that the applicant revise this to state “QME-1-2007, as endorsed by RG 1.100 Revision 3, describes methods that the staff of the NRC considers acceptable for qualification of active mechanical equipment such as pumps, valves, dynamic restraints, and non-metallic parts.”

(2) In MUAP-08015, Section 3.4, “ASME and Other Industry Standards & Codes,” the paragraph titled ASME QME-1 states “ASME QME-1, Qualification of Active Mechanical Equipment Used in Nuclear Power Plants, 2007, including appropriate appendices, provides guidance on qualifying active mechanical equipment.” The staff suggests that the applicant revise this to state “ASME QME-1-2007, “Qualification of Active Mechanical Equipment Used in Nuclear Power Plants,” as endorsed by RG 1.100 Revision 3, describes methods that the staff of the NRC considers acceptable for use in the qualification of active mechanical equipment such as pumps, valves, dynamic restraints, and non-metallic parts. When a licensee commits to use ASME QME-1-2007 for its qualification of mechanical equipment, then the criteria and procedures delineated in ASME QME-1-2007 become part of the requirements for its qualification program.”

(3) In MUAP-08015, Section 3.4, “ASME and Other Industry Standards & Codes,” the paragraph titled, ASME QME-1-2007, Non-mandatory Appendices states “These

sections are intended as a guide in the absence of project specific procedures to direct the PEQO in developing related EQ procedures for the qualifying active mechanical equipment such as pumps, valves, and dynamic restraints." The staff suggests that the applicant revise this to state "These sections are intended as a guide in the absence of project specific procedures to direct the PEQO in developing related EQ procedures for the qualifying active mechanical equipment such as pumps, valves, dynamic restraints, and non-metallic parts. However, if a licensee commits to use the non-mandatory appendix, then the criteria and procedures delineated in the non-mandatory appendix become part of the requirements for its qualification program. For example, if the licensee commits to the use of QME-1-2007 Appendix QR-B for the qualification of non-metallic parts, then the criteria and procedures delineated in the non-mandatory appendix become part of the requirements for its qualification program."

(4) In MUAP-08015, Section 3.4, "ASME and Other Industry Standards & Codes," the paragraph titled ASME QME-1-2007, Non-mandatory Appendices, the staff suggests that the applicant add a new sentence to state "Qualification of non-metallic parts of mechanical equipment shall be performed in accordance with ASME QME-1-2007 Appendix QR-B as endorsed by Regulatory Guide 1.100, Revision 3."

(5) In MUAP-08015, Section 10.3.2, "Mechanical Equipment," states "Active Mechanical Equipment whose function is required to ensure the safe operation or safe shutdown of a nuclear power plant is qualified following the guidance of ASME QME-1." The staff suggests that the applicant revise this to state "Active Mechanical Equipment whose function is required to ensure the safe operation or safe shutdown of a nuclear power plant is qualified following in accordance with ASME QME-1-2007."

03.11-49

MUAP-08015(R1) Section 4.1.1, "Mild Environment," states the maintenance/surveillance program, in conjunction with the preventive maintenance program, provides assurance that equipment meeting the design/purchase specifications is qualified for the designed life of the component. Compliance by the Licensee (owner) with 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," and associated guidance in RG 1.160 are considered sufficient to provide reasonable assurance that environmental considerations established during design are reviewed every refueling outage and maintained on a continuing basis to ensure that the qualified design life has not been reduced by thermal, radiation, and/or cyclic degradation resulting from unanticipated operational occurrences or service conditions."

NRC staff does not consider the Maintenance Rule (10 CFR 50.65) and RG 1.160 to provide sufficient detail to maintain the environmental design and qualification status of safety-related mechanical and electrical equipment. In order to provide assurance that the environmental design and qualification status of equipment will maintain during the operational life of the plant, staff considers it necessary for this equipment to be included in the Licensee Operating Equipment Qualification Program as described in Section 11.0 of MUAP-08015.

Therefore, staff requests the applicant to revise MUAP-08015(R1) Section 4.1.1 to describe that the environmental design and qualification status of components in both

mild and harsh environments are to be maintained by the Licensee Operating Equipment Qualification Program as described in Section 11.0 of MUAP-08015. The staff notes that the applicant is requested to describe that the operating program in Section 11.0 is to contain the aspects specific to the environmental design and qualification of mechanical and electrical equipment in a related question in this RAI.

03.11-50

MUAP-08015(R1) Section 6.2.2, “Substitution,” describes equipment qualification methods for substitute equipment. Staff does not consider the methods described by the applicant in Section 6.2.2 acceptable for substitution of non-metallic components for mechanical equipment. QME-1-2007 Appendix QR-B, Section QR-B5300, “Selection of Qualification Methods,” describes methods that the staff of the NRC considers acceptable for use in qualification of substitute non-metallic components for mechanical equipment. Therefore, the staff requests the applicant to add a new sentence to MUAP-08015(R1) Section 6.2.2 to state, “Qualification of substitute or replacement non-metallic parts of mechanical equipment shall be performed in accordance with ASME QME-1-2007 Appendix QR-B as endorsed by Regulatory Guide 1.100, Revision 3.”

03.11-51

MUAP-08015(R1), Section 6.2.3, “Analysis of Important to Safety Mechanical Equipment,” describes the environmental qualification methods for mechanical equipment and states: “Environmental qualification of important to safety mechanical equipment is required to show that important to safety mechanical equipment can fulfill its intended safety function due to environmental effects of a DBA. This analysis is also intended to minimize the possibility of common mode failures impacting the proper operation of important to safety equipment. Analytical techniques applicable to qualifying mechanical equipment, both seismically and environmentally, are discussed in Sections 7 and 8 of this Technical Report.” However, staff does not consider analysis alone an acceptable method for the environmental qualification of mechanical equipment.

Acceptable environmental qualification methods include testing or a combination of testing and analysis in accordance with ASME QME-1-2007. Therefore, staff requests the applicant to revise Section 6.2.3 as follows: (1) change the section title from “Analysis of Important to Safety Mechanical Equipment,” to “Qualification of Important to Safety Mechanical Equipment,” and (2) revise the complete paragraph to conform with the environmental qualification requirements in the DCD as follows: “Environmental qualification of important to safety mechanical equipment is required to show that important to safety mechanical equipment can fulfill its intended safety function for the postulated design basis environmental conditions. Qualification is also intended to minimize the possibility of common mode failures impacting the proper operation of important to safety equipment. The qualification process applicable to qualification of mechanical equipment, both seismically and environmentally, is discussed in Sections 7 and 8 of this Technical Report. Non-metallic components of mechanical equipment located in a harsh environment are qualified in accordance with ASME QME-1-2007, Appendix QR-B as endorsed by RG 1.100 revision 3. Acceptable design of non-metallics located in a mild environment is demonstrated by the design/purchase specifications which contains a description of the functional requirements for all anticipated service

conditions. Environmental design and qualification status of non-metallic components in both harsh and mild environments is maintained during the operational life of the plant by maintenance and surveillance procedures as described in Section 11.0 of MUAP-08015."

03.11-52

In Sections 8.0 and 9.0 of Technical Report MUAP-08015 (R1), the applicant describes generic and project specific qualification programs to be developed based on the requirements committed to in the DCD. Specifically, sections 8.3.20 and 9.4 identify procedure "Pro-17, US-APWR EQ Program Qualification by Analysis." Staff approved methods for environmental qualification of mechanical and electrical equipment include testing or a combination of testing and analysis. Staff does not consider analysis alone an acceptable method for environmental qualification of mechanical or electrical equipment. Therefore, staff requests the applicant to further describe program "Pro-17, US-APWR EQ Program Qualification by Analysis" in regard to environmental qualification by analysis of mechanical and electrical equipment.

03.11-53

In Section 10.0 of Technical Report MUAP-08015 (R1), the applicant describes the transfer of the equipment qualification program to the utility licensee prior to fuel load. In Section 10.3.2, Mechanical Equipment," the applicant states that "active mechanical equipment is qualified following the guidance of ASME QME-1." However, the staff approved methodology for qualification of mechanical equipment is ASME QME-1-2007 as endorsed by Regulatory Guide 1.100, Revision 3. Staff request to applicant to clarify that active mechanical equipment is qualified in accordance with ASME QME-1-2007 as endorsed by Regulatory Guide 1.100, Revision 3.

03.11-54

In Section 11.0 of Technical Report MUAP-08015 (R1), the applicant provides a general description of the Licensee Operating Equipment Qualification Program (OEQP). As discussed in Regulatory Guide 1.206 and Commission Paper SECY-05-0197, COL applicants must fully describe their operational programs to avoid the need for ITAAC regarding those programs. There are specific aspects the staff considers necessary to fully describe an environmental qualification operational program.

Therefore, the NRC staff requests that MHI further address the operational aspects of the EQ program in Section 11.0 of Technical Report MUAP-08015. For example, the U.S. US-APWR DCD should indicate that the environmental qualification operational programs will include the following aspects: (1) evaluation of environmental qualification results for design life to establish activities to support continued environmental qualification; (2) determination of surveillance and preventive maintenance activities based on environmental qualification results; (3) consideration of environmental qualification maintenance recommendations from equipment vendors; (4) evaluation of operating experience in developing surveillance and preventive maintenance activities for specific equipment; (5) development of plant procedures that specify individual

equipment identification, appropriate references, installation requirements, surveillance and maintenance requirements, post-maintenance testing requirements, condition monitoring requirements, replacement part identification, and applicable design changes and modifications; (6) development of plant procedures for reviewing equipment performance and environmental qualification operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the environmental qualification operational program; and (7) development of plant procedures for the control and maintenance of environmental qualification records.

03.11-55

The ITAAC for the environmental qualification (EQ) of US-APWR components listed in Tier 1 of the US-APWR FSAR do not appear to be consistent with the EQ requirements specified in Tier 2 of the US-APWR FSAR. Also, the ITAAC are specific to Class 1E equipment and but should include mechanical equipment. For example, the Design Commitment for ITAAC 9.a in Table 2.4.2-5, “Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria,” in US-APWR FSAR Tier 1 states “Class 1E equipment identified in Table 2.4.2-2, as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.” However, Tier 2, Section 3.11, “Environmental Qualification of Mechanical and Electrical Equipment,” of US-APWR FSAR states that equipment designated as safety-related or important to safety is addressed in the Environmental Qualification Program to verify it is capable of performing design safety function under all anticipated service conditions including normal operation, anticipated operational occurrences, and design basis accidents for the time required to perform the safety function. Therefore, to be consistent with the EQ requirements in Tier 2, Section 3.11, staff suggests that ITAAC 9.a of Table 2.4.2-5 and similar EQ ITAAC in other Tier 1 system tables be revised using the following example.

Design Commitment 9.a: Equipment identified in Table 2.4.2-2 as being qualified for a harsh environment will be capable of performing design safety function under all anticipated service conditions including normal operation, anticipated operational occurrences, and design basis accidents for the time required to perform the safety function.

Inspections, Tests, Analyses 9.a.i: Type tests or a combination of type tests and analysis will be performed on the equipment identified in Table 2.4.2-2 located in a harsh environment to verify the capability of performing design safety function under all anticipated service conditions including normal operation, anticipated operational occurrences, and design basis accidents for the time required to perform the safety function.

Acceptance Criteria 9.a.i: An Environmental Qualification Data Report (EQDR) exists and concludes that the equipment identified in Table 2.4.2-2 as being qualified for a harsh environment will be capable of performing design safety function under all anticipated service conditions including normal operation, anticipated operational occurrences, and design basis accidents for the time required to perform the safety function.

03.11-56

NUREG-0800, “Standard Review Plan,” Section 3.11, “Environmental Qualification of Mechanical and Electrical Equipment,” states that for mechanical equipment, the applicant has identified non-metallic subcomponents of safety-related equipment located in harsh environments. However, the tables in US-APWR DCD Tier 2, Appendix 3D do not identify non-metallic subcomponents for mechanical equipment. The applicant is requested to identify non-metallic subcomponents for mechanical equipment in Appendix 3D or describe how these subcomponents are identified.

03.11-57

MUAP-08015(R1) Attachment B, “Description of US-APWR Equipment Seismic Qualification Program,” describes the program for seismic and dynamic qualification of equipment. Section B.4 of Attachment B, “Codes and Standards for Seismic/Dynamic Qualification,” states “the program for seismic and dynamic qualification compliments, and is consistent with technical requirements and parameters that are specific of the US-APWR DCD, particularly those of Chapter 3, Section 3.7, 3.10 and 3.11. The equipment seismic qualification program technical requirements are based largely on those contained within IEEE Std 344 and ASME QME-1 (for functional qualification).” However, to be consistent with the technical requirements in the US-APWR DCD and Chapter 3.11, staff suggests the applicant to revise the following sections of Attachment B.

(1) The 2nd paragraph of Section B.4 describing ASME QME-1-2007, Non-mandatory Appendices states “These sections are intended as a guide in the absence of project specific procedures to direct the PEQO in developing related EQ procedures for the qualifying active mechanical equipment such as pumps, valves, and dynamic restraints.” This sentence should be revised to states “These sections are intended as a guide in the absence of project specific procedures to direct the PEQO in developing related EQ procedures for the qualifying active mechanical equipment such as pumps, valves, and dynamic restraints. However, if a licensee commits to use the non-mandatory appendix, then the criteria and procedures delineated in the non-mandatory appendix become part of the requirements for its qualification program. For example, if the licensee commits to the use of QME-1-2007 Appendix QR-B for the qualification of non-metallic parts, then the criteria and procedures delineated in the non-mandatory appendix become part of the requirements for its qualification program.”

(2) In the 4th paragraph of Section B.4 describing qualification for mechanical components, add a new sentence to state “Qualification of non-metallic parts of mechanical equipment shall be performed in accordance with ASME QME-1-2007 Appendix QR-B as endorsed by Regulatory Guide 1.100, Revision 3.”

03.11-58

Technical Report MUAP-08015 (R1) contains a section titled, “EQ Summary Data Sheet, Environmental Qualification Report, and Seismic Qualification Report Formats.” However, the generic report format in this section does not describe an EQ Summary Data Sheet or an Environmental Qualification Report. Therefore, staff requests the

applicant to describe the Environmental Qualification Summary Data Sheet and Environmental Qualification Report for the qualification of mechanical and electrical equipment.

03.11-59

Technical Report MUAP-08015 (R1) contains a section titled, “EQ Program Procedures.” Staff approved methodology for qualification mechanical equipment is by test or a combination of test and analysis in accordance with QME-1-2007 as endorsed by RG 1.100 Revision 3. Based on this, staff requests the applicant to address the following items concerning this section.

(1) In the section “EQ Program Procedure Pro-18 EQ Qualification by Testing,” the reference to “QME-1” should be revised to “QME-1-2007.”

(2) In the section “EQ Program Procedure Pro-19 EQ Qualification by Vendor Certification,” the reference to “QME-1” should be revised to “QME-1-2007.”

(3) The section “EQ Program Procedure Pro-20 EQ Qualification by Analysis,” should provide a sentence to clarify that mechanical equipment is functionally qualified by test or a combination of test and analysis in accordance with QME-1-2007 as endorsed by RG 1.100 Revision 3. Analysis alone is not an acceptable method to functionally qualify mechanical equipment.

03.11-60

Technical Report MUAP-08015(R1) provides the calculated environmental qualification parameters for US-APWR plants. These environmental parameters are considered in the qualification of safety-related and important to safety equipment. However, the DCD does not clarify that the functional design and qualification of active mechanical equipment (such as pumps and valves) shall include the potential impact of the adverse environmental conditions described in Technical Report MUAP-08015. For example, the design and qualification of electric motors needs to reference the adverse environmental conditions described in Technical Report MUAP-08015 since the motors might produce less torque under high temperature conditions than under normal conditions, which could impact their capability to operate their individual pumps or valves. Therefore, the staff requests that the applicant clarify that the functional design and qualification of active mechanical equipment such as pumps and valves shall include the potential impact of the adverse environmental conditions described in MUAP-08015.