# RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

**APR1400 Design Certification**

**Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD**

**Docket No. 52-046**

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| **RAI No.:** | **115-8066** |
| **SRP Section:** | **03.11 - Environmental Qualification of Mechanical and Electrical Equipment** |
| **Application Section:** | **3.11** |
| **Date of RAI Issue :** | **07/27/2015** |

## Question No. 03.11-3

APR1400 DCD Tier 2, Section 3.11.2, “Qualification Tests and Analysis,” states at the bottom of p. 3.11-5 that safety-related active mechanical equipment is listed in APR1400 DCD Tier 2, Table 3.11-3, “Equipment Qualification Equipment List.” This DCD section also states in a later paragraph (second paragraph on p. 3.11-6) that safety-related mechanical equipment is specified in APR1400 DCD Tier 2, Table 3.11-3. Based on this, it is not clear to the staff whether the scope of mechanical equipment included in the environmental qualification program includes safety-related mechanical equipment or safety-related active mechanical equipment. Therefore, staff has the following questions to support a finding under acceptance criterion 14 of SRP Section 3.11, which relates to the applicant's identification of safety-related mechanical equipment located in harsh environment areas (and, therefore, the need to define the scope of the program).

a) Staff requests the applicant to describe the scope of mechanical equipment listed in APR1400 DCD Tier 2, Table 3.11-3 and Part 1 of Technical Report APR1400-E-X-NR-14001-P, Table 3, “Equipment Qualification Equipment List,” and the basis for determining the mechanical equipment included in the environmental qualification program. Also, the applicant is requested to identify any non-safety related mechanical equipment included in the environmental qualification program.

b) Staff requests the applicant to clarify in the DCD and technical report the environmental qualification methodology for safety-related active mechanical equipment and safety-related mechanical equipment

## Response

a) The basis for determining the mechanical equipment in the environmental qualification program is if the equipment is classified as safety related and Seismic Category I.

There is not any non-safety related mechanical equipment in DCD Tier 2, Table 3.11-3 or Part 1 of Technical Report APR1400-E-X-NR-14001-P, Table 3, “Equipment Qualification Equipment List.” The tables list equipment classified as safety related and Seismic Category I only.

b) The environmental qualification methodology for safety related active mechanical equipment and safety related mechanical equipment will be elaborated upon in more detail in DCD Section 3.11.2 and in the Technical Report Section 5.6 as follows:

Environmental qualification of mechanical equipment conforms to GDCs 1 and 4, and 10 CFR Part 50, Appendix B, Criteria III and XVII which requires:

a. Components shall be designed to be compatible with the postulated environmental conditions including those associated with LOCAs.

b. Qualification records shall be maintained and shall include the results of tests and material analyses.

c. Design control measures shall be established for verifying the adequacy of design

Mechanical equipment is principally divided into active and non-active (passive) mechanical equipment.

Environmental qualification of mechanical equipment is focused on the materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms) and is limited to active mechanical equipment located in harsh environment which has mechanical moving parts to perform its safety related function. The qualification effort requires the evaluation of all safety related nonmetallic parts against the applicable environmental conditions.

Non-active mechanical equipment (passive mechanical equipment), whose safety function is structural integrity, are designed and qualified for the appropriate temperature and pressure environment in accordance with the applicable code to which it is constructed such as ASME Pressure Vessel Codes.

The followings shall be confirmed in implementing the environmental qualification of active mechanical equipment:

a. To identify safety-related mechanical equipment located in harsh environment areas, including its required operating time

b. To identify nonmetallic subcomponents of such equipment

c. To identify the environmental conditions and process parameters for which this equipment must be qualified

d. To identify nonmetallic material capabilities.

The COL applicant is to identify the nonmetallic parts of mechanical equipment in the procurement process (COL 3.11 (4)).

e. To evaluate environmental effects

The service requirements and the environmental requirements are defined in the APR1400 design specification for this equipment.

Materials are selected based on extensive testing and long-time service that is compatible with the requirements. Quality assurance of design and quality control of processes provide reasonable assurance that the component meets the specification requirements. Further, the design and manufacturing organizations certify compliance. In-service surveillance and maintenance programs, followed by refurbishment or replacement of parts, if necessary, provide further assurance that the safety equipment will remain operable.

The evaluation of environmental adequacy of the equipment is initiated by the full definition of environmental requirements in the APR1400 design specification, as stated above. Test reports and analyses that substantiate operability after exposure to the environment, and the quality assurance documentation, are to be filed by the operating licensee.

The results of environmental qualifications are included as a part of the equipment qualification reports. These reports are used to establish the maintenance and repair plan for the equipment and procurement of the parts for the life of the plant. If the components are replaced or qualified by other methods, the reports should be traceable.

The safety related active mechanical equipment that contains nonmetallic parts is also environmentally qualified in accordance with ASME Standard QME-1-2007 "Qualification of Active Mechanical Equipment," QR-B, "Guide for Qualification of Non-Metallic Parts."(Reference 9.31), as endorsed by RG 1.100, Revision 3, and is listed in Table 3.11-3 as specified by RG 1.206, Section C.I.3.11.6.

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**Impact on DCD**

DCD Section 3.11.2 will be revised as indicated in Attachment 1.

**Impact on PRA**

There is no impact on the PRA.

**Impact on Technical Specifications**

There is no impact on the Technical Specifications.

**Impact on Technical/Topical/Environmental Reports**

Technical Report APR1400-EX-NR-14001-P/NP will be revised as indicated in Attachment 2.

A description of the qualification method is contained in a qualification report for each type of equipment. The qualification method encompasses appropriate combinations of any or all of the type testing, operating experience, and analysis.

The typical approach used for the qualification of equipment potentially exposed to a harsh environment is as follows:

a. Evaluate the equipment life capability according to the planned design life service exposure to normal and abnormal environmental conditions plus the worst-case accident exposure condition.

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b. Use the Arrhenius methodology on weak link materials if test data exist to derive the qualified life indicated above item.

~~Environmental qualification of mechanical equipment conforms with GDCs 1 and 4, and 10 CFR Part 50, Appendix B, Criteria III and XVII, and includes the following:~~

~~a. Identification of safety-related mechanical equipment located in harsh environments, including required operating times~~

~~b. Identification of nonmetallic subcomponents of this equipment~~

~~c. Identification of the environmental conditions for which this equipment must be qualified~~

~~d. Identification of nonmetallic material capabilities. The nonmetallic parts (e.g., seals, gaskets, lubricants) may be changed by equipment suppliers.~~
~~The COL applicant is to identify the nonmetallic parts of mechanical equipment in the procurement process (COL 3.11 (4)).~~

~~e. Evaluation of environmental effects~~

~~The safety-related active mechanical equipment that may contain non-metallic parts are qualified in accordance with ASME Standard QME-1-2007, as endorsed by RG 1.100, Revision 3, and is listed in Table 3.11-3 as specified by RG 1.206, Section C.I.3.11.6.~~

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a. Components shall be designed to be compatible with the postulated environmental conditions including those associated with LOCAs.

b. Qualification records shall be maintained and shall include the results of tests and material analyses.

c. Design control measures shall be established for verifying the adequacy of design

Mechanical equipment is principally divided into active and non-active (passive) mechanical equipment.

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The followings shall be confirmed in implementing the environmental qualification of active mechanical equipment:

a. To identify safety-related mechanical equipment located in harsh environment areas, including its required operating time

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   The COL applicant is to identify the nonmetallic parts of mechanical equipment in the procurement process (COL 3.11 (4)).

e. To evaluate environmental effects

The service requirements and the environmental requirements are defined in the APR1400 design specification for this equipment.

Materials are selected based on extensive testing and long-time service that is compatible with the requirements. Quality assurance of design and quality control of processes provide reasonable assurance that the component meets the specification requirements. Further, the design and manufacturing organizations certify compliance. In-service surveillance and maintenance programs, followed by refurbishment or replacement of parts, if necessary, provide further assurance that the safety equipment will remain operable.

The evaluation of environmental adequacy of the equipment is initiated by the full definition of environmental requirements in the APR1400 design specification, as stated above. Test reports and analyses that substantiate operability after exposure to the environment, and the quality assurance documentation, are to be filed by the operating licensee.

The results of environmental qualifications are included as a part of the equipment qualification reports. These reports are used to establish the maintenance and repair plan for the equipment and procurement of the parts for the life of the plant. If the components are replaced or qualified by other methods, the reports should be traceable.

The safety related active mechanical equipment that contains nonmetallic parts is also environmentally qualified in accordance with ASME Standard QME-1-2007 "Qualification of Active Mechanical Equipment," QR-B, "Guide for Qualification of Non-Metallic Parts."(Reference 9.31), as endorsed by RG 1.100, Revision 3, and is listed in Table 3.11-3 as specified by RG 1.206, Section C.I.3.11.6.

~~The safety-related active mechanical equipment that may contain non-metallic parts are qualified in accordance with ASME Standard QME-1-2007, as endorsed by RG 1.100, Revision 3, and is listed in Table 3.11-3 as specified by RG 1.206, Section C.I.3.11.6.~~

~~The safety-related mechanical equipment that may contain nonmetallic parts is specified in Table 3.11-3 in accordance with ASME Standard QME-1-2007, as endorsed by RG 1.100,~~ Revision 3. ~~The nonmetallic subcomponent (e.g., seals, gaskets, lubricants) materials are identified in the procurement process, and are expected to change by vendors.~~

3.11.2.1 Environmental Qualification during Normal Operation

Equipment which is not significantly affected environmentally by the design basis accident (DBA) is said to exist in a mild (normal plus abnormal service conditions) environment. For the qualification of both electrical and mechanical equipment in a mild environment, a qualified life is not required if no significant aging mechanism in mild conditions is identified in accordance with IEEE Std. 323. If the predicted life based on experience, aging analysis, or tests is less than the design life of the plant, that equipment is subjected to a surveillance program and a preventative maintenance program that restores it to qualified operability. The detailed maintenance or surveillance program for specific plants is to be developed based on the specific equipment for the APR1400 and the results of qualification testing and analysis for that equipment.

The ranges of the design temperatures, pressures, relative humidity, and radiation for typical mild environment areas in which safety-related equipment is located are provided in Table 3.11-2.

3.11.2.2 Environmental Qualification during and after a Design Basis Accident

Equipment located in harsh environments is designed to remain functional in the environment that exists at the equipment location, for the length of time during and after the DBA for which it is required to be functional, and for the integrated radiation dose during normal operation. The temperature, pressure, and humidity environment inside the containment after a LOCA and MSLB is discussed in detail in Subsections 6.2.1.3 and 6.2.1.4. The containment spray characteristics are given in Subsection 6.2.2.1. The worst-case integrated post-accident radiation doses for those areas at which equipment is located are provided in Table 3.11-2.

The preventative maintenance will include, as appropriate:

a. Visual inspection

b. Mechanical inspection

c. Electrical testing

d. Periodic tests

e. Failure trending

f. Incipient failure detection

It is anticipated that most of these tests are already included in Technical Specifications requirements.

Data maintenance and storage in a central file, and evaluation activities such as the S/PM program, are the responsibility of the utility.

Because of its location, access to equipment in the containment building may be limited for surveillance/ preventive maintenance or periodic calibration.

## 5.5 CONSERVATISM OF QUALIFICATION PARAMETERS

The levels of environmental qualification required are specified in the EQPR. Accident conditions of these requirements are established based on the methods recommended by NRC RG 1.89 and NUREG-0588. Margins utilized per Section 6.3.1.6 of IEEE Std 323, Section 3 of NUREG-0588, and as described in Subsection 5.1.3 will be documented in the appropriate qualification document. Comparison of the qualification requirements to the environmental test parameters will demonstrate conservatism of the parameters. Margin identification and verification will be performed.

## 5.6 QUALIFICATION OF SAFETY-RELATED ACTIVE MECHANICAL EQUIPMENT

~~Environmental qualification of active mechanical equipment complies with General Design Criteria (GDC) 1 and 4, and 10 CFR 50, Appendix B, Criteria III and XVII, and includes the following:~~

~~a. Identification of safety related active mechanical equipment located in harsh environments, including required operating times~~

~~b. Identification of non-metallic subcomponents of this equipment~~

~~c. Identification of the environmental conditions for which this equipment must be qualified~~

~~d. Identification of non-metallic material capabilities. The non-metallic parts (e.g. seals, gaskets, lubricants) may be changed by equipment suppliers.~~

~~For this equipment, the service requirements and the environmental requirements are defined in the APR1400 design specification.~~

~~Materials are selected based on extensive testing and long time service that is compatible with the requirements. Quality assurance of design and quality control of processes provide reasonable assurance that the component meets the specification requirements. Further, the design and manufacturing~~



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~~organizations certify compliance. In-service surveillance and maintenance programs, followed by refurbishment or replacement of parts if necessary, provide further assurance that the safety equipment will remain operable.~~

~~The evaluation of environmental adequacy of the equipment is initiated by the full definition of environmental requirements in APR1400 design specification, as stated above. Test reports and analyses that substantiate operability after exposure to the environment, and the quality assurance documentation, are to be filed by an operator.~~

~~The results of environmental qualifications are included as a part of the equipment qualification reports. These reports are used to establish the maintenance and repair plan for the equipment and procurement of the parts for the life of the plant. If the components are replaced or qualified by other methods, the reports should be traceable.~~

~~The safety-related mechanical equipment that may contain non-metallic parts (e.g., seals, gaskets, lubricants) is qualified in accordance with ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment," or QR-B, "Guide for Qualification of Non-Metallic Parts."(Reference 9.31)~~