RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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

Docket No. 52-046

RAI No.:	**184-8209**
SRP Section:	**03.11 - Environmental Qualification of Mechanical and Electrical Equipment**
Application Section:	**3.11**
Date of RAI Issue :	**08/31/2015**

Question No. 03.11-12

a) In DCD Tier 2, Revision 0, Section 3.11.1.3, “Equipment Operability Times” provides a description of the operational time during which the equipment is required to operate in the accident environment. Operational times are defined as continuous, short-term, intermittent, and varies. Short-term operational time is defined as the “component is required to operate one time during the design basis accident (i.e., approximately a few seconds up to a few hours depending on the component and the event). This definition it is not clear as to how these operational times of short-term equipment will be determined component wise. Please clarify with example.

b) It is essential that safety-related electric equipment be qualified to demonstrate that it can perform its safety function under the environmental service conditions in which it will be required to function and for the length of time its function is required. Also discuss how the applicant determines that the margin applied to the minimum operability time, when combined with the other test margins, will account for the uncertainties associated with the use of analytical techniques in the derivation of environmental parameters, as per RG 1.89 (C.4).

Response

a) Equipment listed as short-term, intermittent, continuous, and varies in the tables of DCD section 3.11 and in the Technical Report were determined based on each component’s functional requirement during an accident.

For example, in the case of Main Steam Isolation Valves and Economizer Main Feedwater Isolation Valves, their required operational times are classified as short-term in DCD section 3.11 and in the Technical Report APR1400-E-X-NR-14001-P Tables. The reason is because these valves are normally open during normal operation and automatically close to isolate the feedwater and steam flow to/from the steam generator upon receipt of a Main

Steam Isolation Signal (MSIS) during an accident condition. These valves are only required to close after receipt of a MSIS at the beginning of an accident and will remain closed in the post-accident events.

Consequentially, the operational times of the valves have been determined as short-term since they operate in a short time from the accident initiation (i.e., immediately after receipt of a MSIS).

b) Although safety related equipment of the same type may be provided by the same supplier, the specific required operational time during normal/accident conditions will vary according to the system functional requirements. This means that the same safety related equipment may be operated at an early stage, middle or continuously in the accident period (taken to be one year including the post-accident period). Therefore, it is neither effective nor economical for equipment suppliers to qualify their equipment on a case-by-case basis to specific conditions.

Thus, procurement requirements are generally established that specify supplied equipment meet the normal and one year accident conditions. This is normally the most limiting condition from a qualification perspective. By doing so, the uncertainties associated with minimum operability time, combined with the other test margins such as environmental stress margins and operational stress margins are assured and the qualification is therefore conservatively implemented.

Impact on DCD

There is no impact on the DCD.

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

There is no impact on any Technical, Topical, or Environmental Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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

Docket No. 52-046

RAI No.:	**184-8209**
SRP Section:	**03.11 - Environmental Qualification of Mechanical and Electrical Equipment**
Application Section:	**3.11**
Date of RAI Issue :	**08/31/2015**

Question No. 03.11-13

In DCD Tier 2, Revision 0, Section 3.11.2.3, “Environmental Qualification Method,” talks about synergistic effects. Sub-section a. “Qualification by test,” states that “Synergistic effects are considered in the aging program where synergistic effects have been identified on materials that are included in the equipment being qualified.” It is also mentioned in the same Section 3.11.2.3, that “synergistic effects are evaluated to verify that these effects do not adversely affect the qualification of the mechanical, electrical, and I&C equipment, as required in accordance with 10 CFR 50.49(e)(7).” Describe briefly how the applicant will consider synergistic effects with respect to harsh environmental conditions in the qualification for electrical, mechanical, and I&C equipment which will be qualified under 10 CFR 50.49.

Response

Synergistic effects are the effects which result from two or more stresses acting together, as distinguished from the effects of the stresses applied separately. Since these effects shall be identified in the qualification process, the consideration of them shall be taken into account in the qualification tests or analyses performed by equipment supplier.

The procurement specifications state that the equipment is to consider the synergistic effects in the qualification process. Consequentially, KHNP reviews to ensure that the synergistic effects are properly considered in the qualification documentation prepared by the supplier and evaluates that these effects do not adversely affect the environmental qualification required in accordance with 10 CFR 50.49(e)(7).

Impact on DCD

There is no impact on the DCD.

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

There is no impact on any Technical, Topical, or Environmental Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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

Docket No. 52-046

RAI No.:	**184-8209**
SRP Section:	**03.11 - Environmental Qualification of Mechanical and Electrical Equipment**
Application Section:	**3.11**
Date of RAI Issue :	**08/31/2015**

Question No. 03.11-15

In DCD Tier 2, Revision 0, Section 3.11.2.3, “Environmental Qualification Method,” subsection b, “Qualification by analysis” states, “If qualification documentation for other equipment is available, it is reviewed to determine if the qualified equipment is similar to that being procured.” Subsection c, “Qualification by operating experience,” also states this qualification method will be performed “similar equipment with a successful operating history in a service environment equal to or more severe than the environment for the equipment in question.” However, it is not defined in this chapter or the equipment qualification program, APR1400-E-X-NR-14001-P, Rev. 0, what are the attributes that are to be compared to define and establish similarity under the EQ program. 10 CFR 50.49 (f) (2) and (3) states that each electrical equipment important to safety must be qualified by Testing a similar item of equipment or by experience with identical or similar equipment under similar conditions with a supporting analysis to show that the equipment to be qualified is acceptable.

a) What are the attributes that are to be compared to define and establish similarity under the EQ program?

b) Provide a discussion on the determination of the qualified equipment and the process of qualifying it, when analyses are done by means of “Similarity”. Provide the definition in the DCD.

Response

a) The equipment qualification can be performed by test, analysis, operating experience and any combination thereof. In addition, in order for the analysis and operating experience to be applied to the equipment qualification and to define and establish similarity, the following attributes are compared.
    1) Material
    2) Size

3) Shape
4) Stress
5) Aging Mechanism
6) Function

That is, as a minimum requirement, the qualified equipment and that to be procured shall have the same or equivalent attributes including material, size, shape, stress and aging mechanisms.

b) A more detailed description of the process of qualifying by analysis, including similarity, will be provided in section 3.11.2.3b of the DCD as follows:

If qualification documentation for other equipment is available, it is reviewed to determine if the qualified equipment is similar to that being procured. If the former is enveloped by the latter, then an analysis to determine qualification life is performed using the existing data.

In addition, if extrapolation and interpolation techniques to extend the application of test data (basically, equipment similarity analysis) are used, the following criteria should be met:

Material:

Materials of construction shall either be the same or equivalent. Any identified differences shall be shown not to adversely affect performance of the safety function(s).

Size:

Size may vary if the basic configuration remains the same and dimensions are related to known scaling factors. Consideration shall be taken of such factors as thermal effects of different surface areas and seismic effects of different masses and modes.

Shape:

The shape shall be the same or similar (subject to restrictions of size) and any differences shown shall not adversely affect the performance of the safety function(s).

Stress:

Operating and environmental stresses on the new equipment shall be equal to or less than those experienced on the qualified equipment under normal and abnormal conditions.

Aging Mechanisms:

The aging mechanisms that apply to the tested equipment encompass those that apply to the similar equipment.

Function:

The safety function(s) as evaluated shall be the same.

Impact on DCD

DCD section 3.11.2.3.b will be revised as indicated in the Attachment.

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

There is no impact on any Technical, Topical, or Environmental Report.

3.11.2.3 Environmental Qualification Method

a. Qualification by test

Qualification testing is performed on actual equipment to stimulate normal, abnormal, and accident conditions. While testing, the specimen is subjected to accelerated aging. Synergistic effects are considered in the aging program where synergistic effects have been identified on materials that are included in the equipment being qualified. When size or other practical requirements limit or preclude the type testing, this part of demonstration is completed by use of operating experience, analysis of partial type test data, or combinations of these qualification.

b. Qualification by analysis

If qualification documentation for other equipment is available, it is reviewed to determine if the qualified equipment is similar to that being procured. If the former is enveloped by the latter, then an analysis to determine qualification life is performed using the existing data.

c. Qualification by operating experience

In addition, if extrapolation and interpolation techniques to extend the application of test data (basically, equipment similarity analysis) are used, the following criteria should be met:

Material:
Materials of construction shall either be the same or equivalent. Any identified differences shall be shown not to adversely affect performance of the safety function(s).

Size:
Size may vary if the basic configuration remains the same and dimensions are related to known scaling factors. Consideration shall be taken of such factors as thermal effects of different surface areas and seismic effects of different masses and modes.

Shape:
The shape shall be the same or similar (subject to restrictions of size) and any differences shown shall not adversely affect the performance of the safety function(s).

Stress:
Operating and environmental stresses on the new equipment shall be equal to or less than those experienced on the qualified equipment under normal and abnormal conditions.

Aging Mechanisms:
The aging mechanisms that apply to the tested equipment encompass those that apply to the similar equipment.

Function:
The safety function(s) as evaluated shall be the same.