
SUPPLEMENTAL 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.

Supplemental Response

If the qualification of equipment by operating experience uses similarity analysis, the criteria mentioned above shall be used.

Impact on DCD

DCD section 3.11.2.3.b and 3.11.2.3.c 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.



In addition, if extrapolation and interpolation techniques to extend the application of test data (basically, equipment similarity analysis) are used, the following 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 functions(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.

c. Qualification by operating experience

Qualification of equipment using operating experience is used in combination with supporting documentation as a basis for environmental qualification if certification of conformance by the vendor is not feasible. This type of qualification may be used for equipment for which testing is not feasible due to the equipment physical size. This evaluation is performed using similar equipment with a successful operating history in a service environment equal to or more severe than the environment for the equipment in question. The validity of operating experience as a means of qualification is determined from the type and amount of available supporting documentation, the service conditions, and equipment performance.

d. Combined qualification

If similarity analysis is used, the extrapolation and interpolation techniques mentioned in Section 3.11.2.3.b shall be used.

Combined qualification is used for any equipment that cannot be qualified through a full type test. Combined qualification usually entails type test, previous operating experience, and analysis. Partial type tests with extrapolation or analysis, operating experience with extrapolation or analysis, and type tests supplemented with tests of components and analysis are examples of combined qualification. The qualification program for the emergency diesel generator utilizes a combined qualification technique.

Aging for Harsh Environment Equipment

Equipment that is located in zones susceptible to a harsh environment is also exposed to a mild environment before DBA. Such equipment undergoes an aging analysis that focuses on the identification of aging mechanisms that significantly increase the equipment's susceptibility to DBA. If no known significant aging mechanisms are found, a surveillance or preventive maintenance program is developed to monitor for degradation. If an aging mechanism is found that is known to significantly degrade the equipment, that mechanism is analyzed to determine whether an accelerated aging program or a periodic part replacement program is appropriate.

Radiation for Harsh and Non-Harsh Environment Equipment

Equipment is designed for the types and levels of radiation associated with its location. The design includes the normal operation contribution plus the radiation associated with