

ArevaEPRDCPEm Resource

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Subject: U.S. EPR Design Certification Application RAI No. 326 (3955), FSAR Ch. 3
Attachments: RAI_326_CIB1_3955.doc

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 30, 2009, and discussed with your staff on December 3, 2009. Draft RAI Question 03.11-29 was revised as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
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Hearing Identifier: AREVA_EPR_DC_RAIs
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U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020

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)

03.11-19

NUREG-0800, Chapter 3.11, "Environmental Qualification of Mechanical and Electrical Equipment, Revision 3 – March 2007" discusses the following general requirements for environmental design and qualification: The general requirements for environmental design and qualification can be summarized as follows: (1) the equipment shall be designed to have the capability of performing its design safety functions under all anticipated operational occurrences and normal, accident, and post accident environment, and for the length of time for which its function is required; (2) the environmental qualification of equipment located in harsh environment shall be demonstrated by appropriate testing and analyses; and (3) a QA program meeting 10 CFR 50, Appendix B, shall be established and implemented to provide the assurance that all requirements have been satisfactorily accomplished. The environmental design and qualification of mechanical equipment is acceptable when it can be determined that all three requirements have been met.

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2: "As noted in NUREG-1793, Section 3.11.3.2.2, although no detailed requirements exist for mechanical equipment, GDC 1 and 4 and Appendix B to 10 CFR Part 50 (Criteria III, "Design Control," and XVII, "Quality Assurance Records") contain the following requirements related to equipment qualification:

- Components are designed to be compatible with the postulated environmental conditions, including those associated with LOCAs.
- Measures are established for the selection and review of the suitability of application of materials, parts, and equipment that are essential to safety-related functions.
- Design control measures are established for verifying the adequacy of design.
- Equipment qualification records are maintained and include the results of tests and materials analyses."

The guidance contained in NUREG-0800 is used to review the U.S. EPR program for environmental qualification of mechanical equipment. The applicant is requested revise its FSAR to cite and address the guidance in NUREG-0800 for the environmental design and qualification of mechanical equipment for U.S. EPR design certification in lieu of NUREG-1793.

03.11-20

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2: "Mechanical components are qualified by design to perform their required functions under the appropriate environmental effects of normal, abnormal, accident, and post accident conditions as required by GDC 4 and discussed in Appendix 3D."

The statement, "mechanical components are qualified by design," needs to be clarified with regard to environmental design and qualification. "Environmental design" means that the equipment shall be designed to have the capability of performing its design safety functions under all anticipated operational occurrences and normal, accident, and post accident environment. Environmental design requirements apply to all equipment important to safety (i.e., both mild and harsh environments). The term "environmental qualification" means verification of design, limited to demonstrating that mechanical equipment are capable of performing the safety function under significant environmental stresses (i.e., harsh environments) resulting from design basis events in order to avoid common-cause failure. The environmental qualification of equipment located in a harsh environment shall be demonstrated by appropriate testing or analyses. For mechanical components located in a mild environment, acceptable environment design can be demonstrated by the design/purchase specifications and a well-supported maintenance/surveillance program, in conjunction with a good preventive maintenance program provides reasonable assurance that the equipment that meets the design specifications will perform its safety-related function.

The applicant is requested to clarify the statement in RAI 3.11-4, Section 3.11.2.2 that mechanical components are "qualified by design."

03.11-21

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2: "For mechanical equipment, important service conditions (temperature, pressure and chemical exposure) do not significantly change as a result of an accident because mechanical components are routinely exposed to the RCS fluid. Accordingly, radiation is the principal degrading environmental effect that potentially relates to common mode failure and that requires special consideration for maintaining qualification."

NRC staff does not consider this statement acceptable to describe service conditions when mechanical equipment is exposed to process fluid. The NRC staff considers the degradation of mechanical equipment due to thermal and radiation aging is typically more severe than the possible degradation due to other environments. Since most mechanical equipment interfaces with process fluid, the effect of the fluid on the environmental conditions (temperature, radiation, and chemical) shall be considered for the design and qualification of mechanical equipment.

The applicant is requested to revise the statement to describe that equipment that interfaces with process fluid, the effect of the fluid on the environmental conditions (temperature, radiation, and chemical) shall be considered in the design and qualification of mechanical equipment.

03.11-22

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2: "For mechanical equipment, temperature and pressure during abnormal events and DBA do not significantly increase stressors because mechanical components are routinely exposed to RCS fluid. Therefore, normal operation and periodic testing demonstrate that each installed item is functional during normal operation then those items can also operate during a DBA."

The guidance in NUREG-0800 states that mechanical equipment is designed to have the capability of performing its design safety functions under all anticipated operational occurrences and normal, accident, and post accident environment, and for the length of time for which its function is required. The component design is to include all service conditions, including accident conditions. Since most mechanical equipment interfaces with process fluid, the effect of the fluid on the environmental conditions (temperature, radiation, and chemical) is considered in the design and qualification. Acceptable environmental design can be ensured in the design/purchase specifications for the equipment. A well-supported maintenance/surveillance program, in conjunction with a good preventive maintenance program, is sufficient to ensure that equipment that meets the design/purchase specifications provide reasonable assurance that the component will perform its safety-related function for the designed life. Normal operation and periodic testing are alone are not sufficient to demonstrate that each installed item exposed to RCS fluid is functional during normal operation and does not ensure those items can also operate during a DBA.

The applicant is requested to revise the statement that normal operation and periodic testing demonstrate that each installed item is functional during normal operation then those items can also operation during a DBA. Also, since most mechanical equipment interfaces with process fluid, the applicant is requested to address the effect of the fluid on the environmental conditions (temperature, radiation, and chemical).

03.11-23

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2: "the maintenance and surveillance program demonstrates that equipment meets the design specifications and the equipment is qualified for the designed life."

The applicant is requested to describe how the maintenance and surveillance program or other plant programs incorporate certificate of compliance, design life, shelf life, qualified life, and replacement schedule for components with a qualified life less than the plant life to demonstrate that equipment remains qualified.

03.11-24

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2: "Similar to equipment located in mild environments, components are also exposed to RCS fluid. This is an important consideration because it means that the

temperature and pressure stressors effect on equipment is essentially the same during normal operation as it is during accident conditions. Therefore, in lieu of accelerating aging analysis, the aging evaluation for temperature and pressure stressors consists of the specified frequency and test conditions of the surveillance program and the equipment failure analysis/trending program requirements. This simplifies the evaluation of materials that are sensitive to environmental effects because temperature and pressure do not produce a failure mode during accident conditions more than those that occur during normal operation.”

The guidance in NUREG-0800 states that mechanical equipment is designed to have the capability of performing its design safety functions under all anticipated operational occurrences and normal, accident, and post accident environment, and for the length of time for which its function is required. The component design is to include all service conditions, including accident conditions. Since most mechanical equipment interfaces with process fluid, the effect of the fluid on the environmental conditions (temperature, radiation, and chemical) is considered in the design and qualification. The environmental qualification of equipment located in harsh environment shall be demonstrated by appropriate testing and analyses using the most sever conditions. Therefore, NRC staff does not consider the surveillance program and equipment failure analysis/trending program an acceptable alternative to initial testing and analysis to demonstrate qualification of mechanical equipment located in a harsh environment.

The applicant is requested to revise the DCD to be consistent with the SRP provisions for qualification of mechanical equipment in harsh environments.

03.11-25

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2: “The mechanical equipment service condition information critical to qualification is consistent with the information noted in Section 3.9.6, including data such as fluid pressure and temperature used to verify the functional requirements of equipment qualification.” This statement is not clear as related to the potential impact of adverse environmental conditions described in Section 3.11.

The applicant is requested to revise the DCD to clarify that the potential impact of adverse environmental conditions described in Section 3.11 are considered in the functional design and qualification of pumps, valves and dynamic restraints in Section 3.9.6. For example, electric motors might produce less torque under high temperature conditions than under ambient conditions, which could impact their capability to operate their individual pumps or valves.

03.11-26

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2.5: “In the evaluation of environmental effects on non-metallic components, consideration is given to the fact that temperature and pressure values (stressors) are not significantly different during accident conditions than during plant operation because the components are routinely exposed to RCS fluid during plant operation. Therefore, for

those stressors, the material evaluations performed to determine the adequacy for normal operation provide the confidence in performance during abnormal and accident environments as well.”

The guidance in NUREG-0800 states that mechanical equipment is designed to have the capability of performing its design safety functions under all anticipated operational occurrences and normal, accident, and post accident environment, and for the length of time for which its function is required. The component design is to include all service conditions, including accident conditions. Since most mechanical equipment interfaces with process fluid, the effect of the fluid on the environmental conditions (temperature, radiation, and chemical) is considered in the design and qualification. The environmental qualification of equipment located in a harsh environment shall be demonstrated by appropriate testing and analyses.

The applicant is requested to revise the DCD to be consistent with the SRP provisions to qualify mechanical equipment.

03.11-27

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2.6: “Under the maintenance program, routine monitoring of mechanical equipment is performed to identify and prevent age-related degradation of non-metallic parts. The program also verifies that the safety function of the mechanical equipment is maintained in normal, abnormal, and accident environments.”

The statement “under the maintenance program, routine monitoring of mechanical equipment is performed to identify and prevent age-related degradation of non-metallic parts,” is not clear as it relates to prevention of age-related degradation of non-metallic parts.

The guidance in NUREG-0800 states that mechanical equipment is designed to have the capability of performing its design safety functions under all anticipated operational occurrences and normal, accident, and post accident environment, and for the length of time for which its function is required. Environmental qualification of non-metallic components located in harsh environments shall be demonstrated by appropriate testing and analyses. The purpose of a maintenance program is to demonstrate that equipment continues to meet the design specifications and the equipment remains capable of performing its safety function for its design life. Independent of design and qualification of non-metallic parts, a maintenance program is used to monitor the parts during plant operation to ensure they remain functional.

The applicant is requested to delete the discussion of prevention as a part of this section.

03.11-28

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2.6: “To verify the effectiveness of these programs to maintain compliance with GDC 4, the program data and records are reviewed periodically in accordance with the

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI and other inspection, in situ test and monitoring programs. This process demonstrates that the equipment has not suffered degradation, which may include the effects of thermal, radiation, and/or cyclic aging.”

NRC staff expectation is that a maintenance program will provide specific inspection attributes to ensure that mechanical equipment will remain qualified during plant operation. The qualification maintenance requirements are to be based on the following: 1) Qualification evaluation results (for example, periodic replacement of age-susceptible parts before the end of their qualified lives), 2) Equipment qualification-related maintenance activities derived from the qualification report(s), and 3) Vendor recommended equipment qualification maintenance. Vendor recommended maintenance is included if it is required in order to maintain qualification.

The applicant is requested to revise the DCD to further clarify qualification maintenance requirements.

03.11-29

The response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), is not clear regarding the actions by AREVA and COL holder to maintain and retain the mechanical equipment qualification files.

NRC staff requests the applicant to describe the actions to maintain and retain the mechanical equipment qualification files. Also, the applicant is requested to include a COL Item to define the process and procedures for which the equipment qualification files will be accepted and how the files will be retained and maintained in an auditable form for the period that the equipment is installed and/or stored for future use in the nuclear power plant.

03.11-30

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant does not address ITAAC. There are no ITAAC in the EPR FSAR that verify that the as-built mechanical equipment has been environmentally qualified.

The applicant is requested to revise the DCD to include an ITAAC to verify the environmental qualification of the specifically identified mechanical equipment for each applicable U.S. EPR system determined to be within the scope of the EQ program.

03.11-31

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), the applicant states the following in Section 3.11.2.2.5: “Equipment records are maintained, and these records include the results of tests and material analyses used as part of the environmental design and qualification process for each mechanical component.” In that 10 CFR 50.49(j) applies to electrical

equipment, the DCD does not clearly describe the provisions for recording and maintaining the results of environmental design and qualification of safety-related mechanical equipment in mild and harsh environments.

The applicant is requested to revise the DCD to state that record keeping for environmental design and qualification of safety-related mechanical equipment will be maintained to meet the requirements of 10 CFR Part 50, Appendix B.

03.11-32

In response to RAI 96 (991, 1025, 1209), Question 3.11-4, Supplement 2 (ML092590494, dated September 16, 2009), Section 3.11.2.2.6: "Establishing and Maintaining Mechanical Equipment Qualification," describes methods for maintaining equipment qualification. This section does not describe methods to establish mechanical equipment qualification.

The applicant is requested to delete the word establishing from the title in DCD Section 3.11.2.2.6.

03.11-33

NUREG-0800 states that equipment shall be designed to the capability of performing its design safety functions under all anticipated operational occurrences and in normal, accident, and post accident environment, and for the length of time for which its function is required. The applicant is requested to revise the DCD to address the length of time for which the function of each mechanical component is required.