

August 17, 2017

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 67 (eRAI No. 8883) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 67 (eRAI No. 8883)," dated June 20, 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Questions from NRC eRAI No. 8883:

- 03.11-12
- 03.11-13
- 03.11-14

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,



Zackary W. Rad

Director, Regulatory Affairs
NuScale Power, LLC

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8883



RAIO-0817-55491

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8883

Response to Request for Additional Information Docket No. 52-048

eRAI No.: 8883

Date of RAI Issue: 06/20/2017

NRC Question No.: 03.11-12

NRC regulations in GDC 4 require that components important to safety be designed to accommodate the effect of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs. DSRS 3.11, "Design-specific Review Standard for NuScale SMR Design," specifies the following acceptance criteria for the environmental qualification of mechanical equipment:

For mechanical equipment, the staff concentrates its review on materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems and diaphragms). The reviewer confirms that the applicant has (1) identified safety-related mechanical equipment located in harsh or mild environment areas and the required operation time for equipment located in harsh environment areas, and (2) identified nonmetallic subcomponents of such equipment.

DCD Tier 2, Table 3.11-1, "Environmentally Qualified Electrical/I&C and Mechanical Equipment Located in Harsh Environments," provides a list of safety-related mechanical equipment that contain nonmetallic parts located in harsh environments and their required operating time. However, the applicant does not identify safety-related mechanical equipment located in mild environments that may contain nonmetallic subcomponents.

To support a finding under GDC 4, the NRC staff requests the applicant to identify safety-related mechanical equipment located in mild environments that may contain nonmetallic subcomponents.

NuScale Response:

The NuScale design does not currently have any safety-related mechanical equipment located in mild environments that may contain nonmetallic subcomponents. If there are any new safety-related mechanical equipment located in mild environments that may contain non-metallic parts they will be environmentally qualified in accordance with ASME QME-1-2007 as accepted in Regulatory Guide 1.100, Revision 3 to ensure the installed valves are capable of performing



their safety-related function under the full range of fluid flow, differential pressure, electrical conditions and temperature conditions, up to and including DBA conditions (Refer to Table 14.3-1, ITAAC No. 02.08.06).

Impact on DCA:

There are no impacts to the DCA as a result of this response.

Response to Request for Additional Information Docket No. 52-048

eRAI No.: 8883

Date of RAI Issue: 06/20/2017

NRC Question No.: 03.11-13

NRC regulations in GDC 4 require that components important to safety be designed to accommodate the effect of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs. DSRS 3.11, “Design-specific Review Standard for NuScale SMR Design,” specifies the following acceptance criteria for the environmental qualification of mechanical equipment:

Appendix QR-B, “Guide for Qualification of Nonmetallic Parts,” of ASME QME-1-2007 as accepted in RG 1.100 (Revision 3) provides a methodology and documentation of records that the staff finds acceptable to demonstrate that nonmetallic parts of mechanical equipment are designed to accommodate the effects of environmental conditions. The environmental design of nonmetallic parts for mechanical equipment shall consider both the external and internal service conditions of the component. The applicant should apply ASME QME-1-2007, Appendix QR-B, as accepted in RG 1.100 (Revision 3), or describe a suitable alternative in its application for NRC staff review.

DCD Tier 2, Section 3.11.6 states that safety-related mechanical equipment that performs an active function during and following exposure to harsh environmental conditions will be qualified in accordance with ASME QME-1, Appendix QR-B, as described in Section 3.10.

DCD Tier 2, Section 3.11.6 and Tier 2, Appendix 3C.4 states that mechanical equipment required to perform a design function related to safety located in mild environments is qualified in accordance with the provisions of GDC 4. For each piece of equipment selected for environmental qualification, the environmental parameters and the qualification process is listed in the associated equipment qualification record file (EQRF).

DCD Tier 2, Section 3.11.6 states that the programs identified in Section 3.11.2.1 for verifying that electrical equipment located in a mild environment are capable of performing their intended function will also be applied to mechanical equipment located in a mild environment.

The staff approved methodology in ASME QME-1-2007, Appendix QR-B contains specific guidance for qualification of nonmetallic parts of active mechanical equipment that is not



addressed in the programs identified in DCD Section 3.11.2.1 for verifying that electrical equipment located in a mild environment are capable of performing their intended function. To support a finding under GDC 4, the NRC staff requests the applicant to provide the following additional information.

- a. Discuss the intent of adding the phrase “as described in Section 3.10” after ASME QME-1, Appendix QR-B. ASME QME-1, Appendix QR-B addresses environmental qualification for nonmetallic parts of mechanical equipment, however, Section 3.10 addresses provisions for the seismic qualification of equipment.
- b. The NRC staff requests that the applicant describe how they will apply ASME Standard QME-1-2007, Appendix QR-B, as accepted in RG 1.100 (Revision 3), for the environmental qualification of nonmetallic parts of safety-related active mechanical equipment located in harsh and mild environments. If QME-1- 2007 is not applied, provide justification that the qualification process contains qualification parameters for nonmetallic parts of active mechanical equipment.

NuScale Response:

a. FSAR Section 3.11.6 and Appendix 3C.4 erroneously indicates that mechanical equipment subjected to a harsh environment is qualified in accordance with ASME QME-1-2007, Appendix QR-B, as described in Section 3.10. Section 3.10 does not include this description. As stated by Section 3.11.6 and Appendix 3C.4, mechanical equipment subjected to a harsh environment will be qualified in accordance with ASME QME-1-2007, Appendix QR-B by as accepted by Regulatory Guide 1.100 Rev. 3 (Reference 3.11-13). Section 3.11.6 and Appendix 3C.4 have been updated to remove the erroneous reference to Section 3.10.

b. Safety related mechanical equipment will be qualified in accordance with ASME QME-1, 2007, Appendix QR-B, as accepted by RG 1.100 (Revision 3). Qualification testing performed in accordance with ASME QME-1-2007 will verify that the as-designed valves are capable of performing their safety-related function under the full range of fluid flow, differential pressure, electrical conditions and temperature conditions, up to and including DBA conditions (Refer to Table 14.3-1, ITAAC No. 02.08.06).

Impact on DCA:

FSAR Section 3.11 and Appendix 3C have been revised as described in the response above and as shown in the markup provided in this response.

were calculated based on the methodology presented in Topical Report TR-0915-17565-P and Section 12.2.1.13. The assumptions associated with the accident dose rates are discussed in Section 15.0.3. See also the discussion in Appendix 3.C for additional information on normal and accident dose rates used for environmental qualification.

RAI 03.11-8

COL Item 3.11-4: [A COL applicant that references the NuScale Power Plant design certification will ensure the Environmental Qualification Program cited in COL Item 3.11-1 includes a description of how equipment located in harsh conditions will be monitored and managed throughout plant life. This description will include methodology to ensure equipment located in harsh environments will remain qualified if the measured dose is higher than the calculated dose.](#)

3.11.6 Qualification of Mechanical Equipment

Mechanical equipment is qualified and documented in accordance with the General Design Criteria 1, 2, 4, and 23 as demonstrated by the approach presented in this section.

GDC 1 and 4 and Appendix B to 10 CFR Part 50 (Criteria III, "Design Control," XI, "Test Control," and XVII, "Quality Assurance Records") contain the following requirements related to generic equipment qualification methodology which applies to mechanical qualification of equipment:

- Components are designed to be compatible with the postulated environmental conditions, including those associated with loss-of-coolant accidents.
- 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.

Mechanical components, including passive components, are qualified to perform their required functions under the appropriate environmental effects of normal, abnormal, accident, and post-accident conditions as required by GDC 4 and 10 CFR 50 Appendix B. Mechanical equipment qualification verifies the design is capable of functioning during normal, abnormal and accident conditions and includes the effects of the fluid medium (e.g., borated water) on the environmental conditions.

RAI 03.11-13

For mechanical equipment located in a mild environment, acceptable environmental design is demonstrated by the design and purchase specifications for the equipment. The specifications contain a description of the functional requirements for a specific environmental zone during normal environmental conditions and anticipated operational occurrences. The programs identified in Section 3.11.2.1 for verifying that electrical equipment located in a mild environment are capable of performing their intended function will also be applied to mechanical equipment located in a mild environment. For mechanical equipment that must function during or following exposure to a harsh

environment, compliance with the environmental design provisions of GDC 4 are generally achieved by demonstrating that the non-metallic parts/components of the equipment suitable for the postulated design basis environmental conditions. Safety-related mechanical equipment that performs an active function during or following exposure to harsh environmental conditions will be qualified in accordance with ASME QME-1, Appendix QR-B (Reference 3.11-13), ~~as described in Section 3.10~~. Documentation and the status of the testing and analysis are performed in accordance with the processes presented in Appendix 3.C.

Mechanical equipment located in harsh environmental zones is designed to perform under all appropriate environmental conditions. The primary focus with mechanical equipment is on materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms). A list of the mechanical components that contain non-metallic or consumable parts located in harsh environment areas that require EQ is provided in Table 3.11-1.

RAI 03.11-14

3.11.7 Equipment Qualification Operational Program

An EQ operational program is provided that ensures continued capability of qualified mechanical and electrical equipment to perform its design function throughout its qualified life. The EQ operational program contains the following aspects specific to the EQ of mechanical and electrical equipment: (1) evaluation of EQ results to establish activities to support continued EQ for the entire time an item is installed in the plant, (2) determination of surveillance and preventive maintenance activities based on EQ results, (3) consideration of EQ 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 EQ operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the EQ operational program, and (7) development of plant procedures for the control and maintenance of EQ records.

RAI 03.11-14

COL Item 3.11-3: A COL applicant that references the NuScale Power Plant design certification will implement an EQ operational program that incorporates the above aspects specific to the EQ of mechanical and electrical equipment.

3.11.8 References

- 3.11-1 NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment," Revision 1, July 1981.
- 3.11-2 IEEE Std. 323-1974, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.

The following plant areas contain equipment that performs a design function related to safety for equipment qualification:

- Reactor Building (RXB)
- Control Building (CRB)

The CRB and the electrical equipment rooms on RXB elevations 75'-0" and 86'-0" are, by design, considered mild environments.

This section provides background for the EQ program and presents a summary of the program objectives, a program outline, and definitions for terms used in this document. Section 3C.4 identifies qualification criteria. Section 3C.5 presents design specifications. Section 3C.6 presents the equipment qualification methods, which includes: type-testing, analyses, operating experience, a combination of methods, and supplemental methods to aid qualification. Section 3C.7 and Section 3C.8 describe the documentation, including data packages, test reports, and maintenance records needed to support the equipment qualification program.

3C.4 Qualification Criteria

General Design Criteria (GDC) 1, 2, 4, and 23 of 10 CFR 50, Appendix A; Quality Assurance Criteria III, XI, and XVII of 10 CFR 50, Appendix B; and 10 CFR 50.49 establish the regulatory requirements for this program.

RAI 03.11-13

Electrical and active mechanical equipment required to perform design functions related to safety, including instrumentation, must be qualified to operate in environments associated with design basis conditions. GDC 4 requires that structures, systems, and components that perform design functions related to safety be designed to accommodate the environmental effects associated with normal operation, maintenance, testing, and postulated accidents, such as a loss-of-coolant accident (LOCA). The primary objective of environmental qualification is to demonstrate with reasonable assurance that equipment for which a qualified life or condition has been established can perform its design function related to safety without experiencing common-cause failures before, during, and after applicable design basis events. The environmental design requirements apply to equipment required to perform their design function related to safety, including both mild and harsh environments. The environmental qualification procedures described in this appendix define the conditions for which equipment required to perform a design function related to safety must be qualified. Electrical equipment required to perform a design function related to safety located in a harsh environment is qualified in accordance with the requirements of 10 CFR 50.49. Active mechanical equipment required to perform a design function related to safety located in a harsh environment is qualified to comply with the requirements of GDC 4 by incorporating the design-basis environmental conditions into the design process. Mechanical equipment that performs an active design function related to safety during or following exposure to harsh environmental conditions is qualified in accordance with ASME QME-1, Appendix QR-B (Reference 3C-4), ~~as described in Section 3.10.~~

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eRAI No.: 8883

Date of RAI Issue: 06/20/2017

NRC Question No.: 03.11-14

NRC regulations in GDC 4 require that components important to safety be designed to accommodate the effect of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs. DSRs 3.11, "Design-specific Review Standard for NuScale SMR Design," specifies the following acceptance criteria for the environmental qualification of mechanical equipment:

A well-supported maintenance/surveillance program, in conjunction with a good preventive maintenance program, is needed to provide assurance that the environmental design and qualification status of equipment in both mild and harsh environments will be maintained during the operational life of the plant.

The applicant should specify in its DCD/FSAR that the EQ operational program shall contain the following aspects specific to the EQ of mechanical and electrical equipment: (1) evaluation of EQ results to establish activities to support continued EQ for the entire time an item is installed in the plant, (2) determination of surveillance and preventive maintenance activities based on EQ results, (3) consideration of EQ 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 EQ operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the EQ operational program, and (7) development of plant procedures for the control and maintenance of EQ records.

To support a finding under GDC 4, the NRC staff request the applicant to address in its DCD/FSAR that the EQ operational program should contain the above aspects specific to the EQ of mechanical and electrical equipment and the applicant is requested add a COL item to specify that a COL applicant that references the NuScale Power Plant design certification will



address operational aspects for maintaining the environmental qualification status of components after initial qualification.

NuScale Response:

COL 3.11-3 was added to the FSAR Section 3.11 that ensures that a COL applicant referencing the NuScale design certification will include the following aspects specific to the EQ of mechanical and electrical equipment:

Evaluation of EQ results to establish activities to support continued EQ for the entire time an item is installed in the plant;

- Determination of surveillance and preventive maintenance activities based on EQ results;
- consideration of EQ maintenance recommendations from equipment vendors;
- Evaluation of operating experience in developing surveillance and preventive maintenance activities for specific equipment;
- 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;
- Development of plant procedures for reviewing equipment performance and EQ operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the EQ operational program, and;
- Development of plant procedures for the control and maintenance of EQ records.

Impact on DCA:

FSAR Section 3.11.7 has been revised as described in the response above and as shown in the markup provided in this response.

environment, compliance with the environmental design provisions of GDC 4 are generally achieved by demonstrating that the non-metallic parts/components of the equipment suitable for the postulated design basis environmental conditions. Safety-related mechanical equipment that performs an active function during or following exposure to harsh environmental conditions will be qualified in accordance with ASME QME-1, Appendix QR-B (Reference 3.11-13), ~~as described in Section 3.10~~. Documentation and the status of the testing and analysis are performed in accordance with the processes presented in Appendix 3.C.

Mechanical equipment located in harsh environmental zones is designed to perform under all appropriate environmental conditions. The primary focus with mechanical equipment is on materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms). A list of the mechanical components that contain non-metallic or consumable parts located in harsh environment areas that require EQ is provided in Table 3.11-1.

RAI 03.11-14

3.11.7 Equipment Qualification Operational Program

An EQ operational program is provided that ensures continued capability of qualified mechanical and electrical equipment to perform its design function throughout its qualified life. The EQ operational program contains the following aspects specific to the EQ of mechanical and electrical equipment: (1) evaluation of EQ results to establish activities to support continued EQ for the entire time an item is installed in the plant, (2) determination of surveillance and preventive maintenance activities based on EQ results, (3) consideration of EQ 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 EQ operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the EQ operational program, and (7) development of plant procedures for the control and maintenance of EQ records.

RAI 03.11-14

COL Item 3.11-3: A COL applicant that references the NuScale Power Plant design certification will implement an EQ operational program that incorporates the above aspects specific to the EQ of mechanical and electrical equipment.

3.11.8 References

- 3.11-1 NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment," Revision 1, July 1981.
- 3.11-2 IEEE Std. 323-1974, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.