

## Response to SDAA Audit Question

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**Question Number:** A-3.11.2.3-1

**Receipt Date:** 07/31/2023

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**Question:**

Section 3.11.2.3, “Justification for Using Latest Institute of Electrical and Electronics Engineers Standards Not Endorsed by a Regulatory Guide [RGs],” states, “[T]his section provides the description and justification for using the latest IEEE standards not endorsed by current RGs for the qualification of equipment. This justification does not preclude the use of versions of IEEE standards that are currently endorsed by RGs.”

The statement cited above implies that the applicant will be using multiple IEEE Standards not endorsed by current RGs. However, the applicant only provides justification for the IEEE Standard 741-1997 instead of the IEEE Standard 741-1986 for external circuit protection of electric penetration assemblies. The statement above could be interpreted as the applicant will deviate from multiple IEEE standards not endorsed by current RGs. The statement is confusing since in Table 3.11-2, “NRC Guidance and Industry Standards for Environmental Qualification,” the applicant conforms with most of the IEEE Standard, which are endorsed by current RGs.

Therefore, the staff requests the applicant to revise Section 3.11.2.3 to reflect that the only deviation is from IEEE Standard 741-1997 and there are no other deviations from the RGs and the applicant will use the IEEE standards as described in Table 3.11-2, or provide the justification of deviations from other IEEE Standards not endorsed by RGs.

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**Response:**

The US460 standard design approval application (SDAA) Section 3.11.2.3 is revised to identify the specific industry standards to demonstrate environmental qualification not currently endorsed by the NRC. SDAA Section 3.11 is updated to include IEEE 1205-2014 and IEEE 627-2010.

## Follow-Up Discussion

The NRC staff requested further discussion of the exceptions and justification included in the response to Audit Question A-3.11.2.3-1. During a call with the NRC staff on 11/17/2023, NuScale agreed to provide a supplement to the response to Audit Question A-3.11.2.3-1 to clarify the scope of the application of IEEE 1205-2014 and to relocate discussion of IEEE 1205-2014 out of FSAR Section 3.11.2.3 to a more appropriate location.

## Supplemental Response

As clarified during the 11/17/2023 call, NuScale applies IEEE Standard 1205-2014 to equipment important to safety and subject to the Chapter 3.11 Environmental Qualification Program. The guidance related to significant aging mechanisms in IEEE 1205-2014 is supplemented with the criteria for identifying significant aging mechanisms from IEEE 627-2010. The NuScale US460 design complies with IEEE Standard 1205-2014 for electrical equipment subject to the Chapter 3.11 EQ Program with the following clarifications:

Known synergistic effects will be addressed in accordance with RG 1.89 R1

The following editions of the normative reference will be used:

- IEEE 323-1974 for harsh environment electrical equipment,
- IEEE 323-2003 for mild environment electrical equipment,
- IEEE 627-2010

Because IEEE 1205-2014 is now endorsed by RG 1.248, IEEE 1205-2014 no longer needs to be included in FSAR Section 3.11.2.3, "Justification for Using Latest Institute of Electrical and Electronics Engineers Standards Not Endorsed by a Regulatory Guide." NuScale revises FSAR Section 3.11.2.3 to remove discussion of IEEE-1205 2014 that was inserted as part of the original response to A-3.11.2.3-1. NuScale revises FSAR Tables 3.11-2 and 1.9-2 to include discussion of RG 1.248 and IEEE 1205-2014.

Markups of the affected changes, as described in the response, are provided below:

Audit Question A-3.11.2.3-1, Audit Question A-6.1.1-8, Audit Question A-8.1-4

**Table 1.9-2: Conformance with Regulatory Guides**

RG	Title	Rev.	Conformance Status	Comments	Section
1.6	Safety Guide 6 - Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems	0	Not Applicable	The onsite electrical AC power systems do not contain Class 1E distribution systems.	Not Applicable
1.7	Control of Combustible Gas Concentrations in Containment	3	Partially Conforms	The design complies with the intent of RG 1.7 regulatory positions that address atmosphere mixing, hydrogen gas production, and containment structural integrity. However, the design deviates from the positions on hydrogen and oxygen monitors. The design includes a passive autocatalytic recombiner (PAR) that is sized to limit oxygen concentrations to a level that does not support combustion (less than four percent), this results in an inert containment atmosphere. The NuScale design supports an exemption to 10 CFR 50.44(c)(4).	6.2.5
1.8	Qualification and Training of Personnel for Nuclear Power Plants	4	Not Applicable	This guidance governs site-specific programmatic and operational activities that are the responsibility of the applicant or licensee.	Not Applicable
1.9	Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants	4	Not Applicable	The NuScale design does not require or include safety-related emergency diesel generators.	Not Applicable
1.11	Instrument Lines Penetrating the Primary Reactor Containment	1	Not Applicable	No instrument lines penetrate the NuScale Power Module (NPM) containment.	Not Applicable
1.12	Nuclear Power Plant Instrumentation for Earthquakes	3	Partially Conforms	Selection of specific equipment is the responsibility of the applicant or licensee. In addition, seismic instrumentation cannot be installed inside the containment, so Section 3.7.4 indicates seismic instrumentation is installed in the Reactor Building (RXB).	3.7.4 12.3

Table 1.9-2: Conformance with Regulatory Guides (Continued)

RG	Title	Rev.	Conformance Status	Comments	Section
1.244	Control of Heavy Loads at Nuclear Facilities	0	Partially Conforms	This guidance endorses, with clarifications, the following ASME standards for control of heavy loads: <ul style="list-style-type: none"> <li>NML-1-2019, "Rules for the Movement of Loads Using Overhead Handling Equipment in Nuclear Facilities"</li> <li>NOG-1-2020, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)" with exceptions listed in Section 9.1.5</li> <li>Chapters 1-3 of BTH-1-2017, "Design of Below-the-Hook Lifting Devices"</li> </ul>	9.1.5
1.245	Preparing Probabilistic Fracture Mechanics Submittals	0	Not Applicable	The design does not use probabilistic fracture mechanics.	Not Applicable
1.247	Trial - Acceptability of Probabilistic Risk Assessment Results for Advanced Non-Light Water Reactor Risk-Informed Activities	Trial	Not Applicable	This guidance is applicable to non-LWRs. The NuScale design is an LWR.	Not Applicable
<a href="#">1.248</a>	<a href="#">Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Production and Utilization Facilities</a>	<a href="#">0</a>	<a href="#">Partially Conforms</a>	<a href="#">The design complies with IEEE Standard 1205-2014 for electrical equipment subject to the Chapter 3.11 EQ Program with the following clarifications:</a> <ul style="list-style-type: none"> <li><a href="#">Known synergistic effects will be addressed in accordance with RG 1.89 R1</a></li> </ul> <a href="#">The following editions of the normative reference will be used:</a> <ul style="list-style-type: none"> <li><a href="#">IEEE 323-1974 for harsh environment electrical equipment.</a></li> <li><a href="#">IEEE 323-2003 for mild environment electrical equipment.</a></li> <li><a href="#">IEEE 627-2010</a></li> </ul>	<a href="#">3.11</a>
4.1	Radiological Environmental Monitoring for Nuclear Power Plants	2	Not Applicable	This guidance governs site-specific, programmatic environmental monitoring activities that are the responsibility of the applicant or licensee.	Not Applicable
4.2	Preparation of Environmental Reports for Nuclear Power Stations	3	Not Applicable	This guidance governs site-specific environmental evaluation activities that are the responsibility of a license or construction permit applicant.	Not Applicable

Audit Question A-3.11.2.3-1

**3.11.2.3.2**      **Institute of Electrical and Electronic Engineers Standard 627-2010**

Audit Question A-3.11.2.3-1

The NuScale Power Plant US460 standard design applies all four (4) criteria found in IEEE 627-2010 for determining significant aging mechanisms. IEEE 627-2010 and IEEE 1205-2014 include the same definition of a significant aging mechanism specifically tied to degradation that progressively and appreciably renders the equipment vulnerable to failure to perform its specified function(s). Consistent with the definition of significant aging mechanisms, the NuScale Power Plant US460 standard design considers an aging mechanism to be significant when all four criteria in IEEE 627-2010 are satisfied.

**3.11.3**      **Qualification Test Results**

The equipment qualification record file documents the summaries and results of qualification tests for electrical and mechanical equipment located in harsh environments.

Qualification of equipment in mild environments is based on certification of performance in accordance with applicable regulatory guidance. Section 3.11.2 and Table 3.11-2 identify guidance that governs documentation of the summaries and results of seismic qualification tests for electrical and mechanical equipment and components in the harsh environment areas. Appendix 3C provides additional information.

COL Item 3.11-1: An applicant that references the NuScale Power Plant US460 standard design will submit a full description of the Environmental Qualification Program and milestones and completion dates for program implementation.

**3.11.4**      **Estimated Chemical and Radiation Environment****3.11.4.1**      **Chemical Environments**

Appendix 3C defines applicable chemical environments for normal and AOO conditions. The chemical environments from the most limiting design basis event are also considered in the qualification of the equipment and are presented in Appendix 3C.

Chemicals used for water chemistry and pH control are considered as well as the borated water environment that is present inside containment and outside containment. Section 5.2.3 discusses primary side water chemistry, Section 6.1.1 discusses reactor pool and spent fuel pool chemistry, and Section 10.3.5 discusses secondary side water chemistry.

- 3.11-6 Institute of Electrical and Electronics Engineers, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," IEEE Standard 7-4.3.2-2003, Piscataway, NJ.
- 3.11-7 Institute of Electrical and Electronics Engineers, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," IEEE Standard 603-1991, Piscataway, NJ.
- 3.11-8 Institute of Electrical and Electronics Engineers, "IEEE Standard for Qualification of Class 1E Connection Assemblies for Nuclear Power Generating Stations," IEEE Standard 572-2006, Piscataway, NJ.
- 3.11-9 Institute of Electrical and Electronics Engineers, "IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations," IEEE Standard 535-2013, New York, NY.
- 3.11-10 NuScale Power, LLC, "Accident Source Term Methodology," TR-0915-17565-P-A, Revision 4.
- 3.11-11 Institute of Electrical and Electronics Engineers, "IEEE Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations," IEEE Standard 383-2003, Piscataway, NJ.
- 3.11-12 Institute of Electrical and Electronics Engineers, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," IEEE Standard 323-2003, Piscataway, NJ.
- 3.11-13 American Society of Mechanical Engineers, Qualification of Active Mechanical Equipment Used In Nuclear Facilities, ASME QME-1-2017, New York, NY.
- 3.11-14 Institute of Electrical and Electronics Engineers, "IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations," IEEE Standard 497-2016, Piscataway, NJ.
- 3.11-15 [Institute of Electrical and Electronics Engineers, "IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and Other Nuclear Facilities," IEEE Standard 1205-2014, Piscataway, NJ.](#)

Audit Question A-3.11.2.3-1

**Table 3.11-2: NRC Guidance and Industry Standards for Environmental Qualification**

RG	Endorsed Industry Standard	Comments
1.40		Regulatory Guide 1.40 is not applicable because the NuScale Power Plant US460 standard design does not use environmentally-qualified continuous duty motors.
1.63	IEEE Standard 317- 1983 (Reference 3.11-3)	The portion of the RG 1.63 guidance that endorses IEEE-317-1983 is applicable. Requirements of IEEE 741-1997 (Reference 3.11-4) are used for external circuit protection of electrical penetration assemblies instead of IEEE 741-1986 (Reference 3.11-1) as endorsed by RG 1.63. The 1997 version, including the additional design enhancements, is consistent with RG 1.63.
1.73	IEEE Standard 382-2006 (Reference 3.11-5)	This guidance is applicable except for portions directed towards high-temperature gas-cooled reactor designs.
1.89	IEEE Standard 323-1974 (Reference 3.11-2) and implementing criteria of 10 CFR 50.49	This RG is applicable except for aspects specific to boiling water reactors or related to structures, systems and components not relevant to the NuScale design, and the reference to RG 1.4 for source term, because the source term provisions of RG 1.4 are superseded by RG 1.183 for new reactors.  NUREG-0588 Category I guidance is used to enhance the guidance provided by RG 1.89.
1.97 (as supplemented by RG 1.89)	IEEE Standard 497-2016 (Reference 3.11-14) with clarifying positions specified in Section C of RG 1.97.	Section 7.2.13 describes compliance with RG 1.97 and the method used to identify PAM equipment. The NuScale Power Plant US460 standard design does not include Type A PAM variables by design.  The NuScale Power Plant US460 standard design satisfies power supply requirements in Section 6.6 of IEEE Standard 497-2016
1.100	ASME QME-1-2017 (Reference 3.11-13)	The NuScale Power Plant US460 standard design complies with Appendix QR-B of ASME QME-1-2017 with the following exceptions:  QR-B5200, Identification and Specification of Qualification Requirements, (g) material activation energy.  QR-B5300 Selection of Qualification Methods for determination and recording of shelf life of nonmetallics.  QR-B5500 Documentation, (h) shelf life preservation requirements.  Appendix 3C describes the exceptions cited.
1.152	IEEE Standard 7-4.3.2-2003 (Reference 3.11-6)	No exceptions
1.153	IEEE Standard 603-1991 (Reference 3.11-7)	No exceptions
1.156	IEEE Standard 572-2006 (Reference 3.11-8)	No exceptions
1.158	IEEE Standard 535-2013 (Reference 3.11-9)	Regulatory Guide 1.158 is not applicable because the augmented DC power system batteries are non-Class 1E. However, guidance in IEEE Standard 535-2013 is used as supplemental guidance to IEEE Standard 323-2003 (Reference 3.11-12) to address aging of valve regulated lead acid batteries.

**Table 3.11-2: NRC Guidance and Industry Standards for Environmental Qualification (Continued)**

RG	Endorsed Industry Standard	Comments
1.180		Section 7.2.2 contains additional details of electromagnetic interference and radio frequency interference qualification.
1.183		NuScale Topical Report TR-0915-17565-P-A (Reference 3.11-10) and Section 12.2.1 describes an alternate methodology for source terms for design basis events.
1.209	Endorses, in part, IEEE Standard 323-2003 (Reference 3.11-12)	No exceptions
1.211	Endorses, in part, IEEE Standard 383-2003 (Reference 3.11-11)	No exceptions
1.248	<u>IEEE Standard 1205-2014 (Reference 3.11-15)</u>	<p><u>The design complies with IEEE Standard 1205-2014 for electrical equipment subject to the Chapter 3.11 EQ Program with the following clarifications:</u></p> <ul style="list-style-type: none"> <li>• <u>Known synergistic effects will be addressed in accordance with RG 1.89 R1</u></li> </ul> <p><u>The following editions of the normative reference will be used:</u></p> <ul style="list-style-type: none"> <li>• <u>IEEE 323-1974 for harsh environment electrical equipment,</u></li> <li>• <u>IEEE 323-2003 for mild environment electrical equipment,</u></li> <li>• <u>IEEE 627-2010</u></li> </ul>