

July 24, 2017

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 32 (eRAI No. 8823) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 32 (eRAI No. 8823)," dated May 26, 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. 8823:

- 08.02-4
- 08.02-5
- 08.02-6
- 08.02-7

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 Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,



Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8823



Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8823

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

eRAI No.: 8823

Date of RAI Issue: 05/26/2017

NRC Question No.: 08.02-4

RG 1.32 “Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants,” is related to the criteria for power systems and endorses IEEE Std. 308, “Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.”

FSAR Tier 2 Table 8.1-1, “Acceptance Criteria and Guidelines for Electric Power Systems,” states that RG 1.32 is guidance for FSAR Tier 2 Section 8.2, “Offsite Power System” and is noted with a “G” (i.e. Guidance) in the column for FSAR Tier 2 Section 8.1, Table 8.1-1.

FSAR Tier 2 Section 8.2.3.2, “Analysis of Offsite Power System Conformance with Regulatory Framework,” states that RG 1.32 is not applicable to the offsite power system.

The staff requests NuScale to clarify the inconsistency between FSAR Tier 2 Table 8.1-1 and FSAR Tier 2 Section 8.2.3.2.

NuScale Response:

The RG 1.32 entry for the offsite power system in FSAR Table 8.1-1 is incorrect and has been revised to indicate blank (Not Applicable), which is consistent with FSAR Section 8.2.3.2.

NuScale has identified two related revisions to the FSAR. The RG 1.32 entry for the onsite AC power system in FSAR Table 8.1-1 has been revised to indicate blank (Not Applicable), which is consistent with FSAR Section 8.3.1.2.7. The RG 1.32 entry in Table 1.9-2, Conformance with Regulatory Guides, has been revised to be consistent with the above FSAR sections and with FSAR Section 8.3.2.2.2.

Impact on DCA:

FSAR Tables 1.9-2 and 8.1-1 have been revised as described in the response above and as shown in the markup provided in this response.

Table 1.9-2: Conformance with Regulatory Guides

RG	Division Title	Rev.	Conformance Status	COL Applicability	Comments	Section
1.3	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors	2	Not Applicable	Not Applicable	This guidance is only applicable to BWRs.	Not Applicable
1.4	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors	2	Not Applicable	Not Applicable	This RG pertains to existing reactors; RG 1.183 is specified in SRP Section 15.0.3 to be used for new reactors.	Not Applicable
1.5	Safety Guide 5 - Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors	-	Not Applicable	Not Applicable	This guidance is only applicable to BWRs.	Not Applicable
1.6	Safety Guide 6 - Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems	-	Partially Conforms	Applicable	The onsite electrical AC power systems do not contain any Class 1E distribution systems. The EDSS design conforms to the guidance for independence of standby power sources and their distribution systems.	8.3
1.7	Control of Combustible Gas Concentrations in Containment	3	Not Applicable	Not Applicable	The containment vessel design is such that its integrity does not rely on combustible gas control systems.	6.2
1.8	Qualification and Training of Personnel for Nuclear Power Plants	3	Not Applicable	Applicable	Site-specific programmatic and operational activities are the responsibility of the COL applicant.	Not Applicable
1.9	Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants	4	Not Applicable	Not Applicable	Based on reduced reliance on AC power, the design does not require or include safety-related emergency diesel generators.	8.3
1.11	Instrument Lines Penetrating the Primary Reactor Containment	1	Not Applicable	Not Applicable	No lines penetrate the NPM containment.	6.2

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

RG	Division Title	Rev.	Conformance Status	COL Applicability	Comments	Section
1.32	Criteria for Power Systems for Nuclear Power Plants	3	Partially Conforms	Applicable	The NuScale passive safety systems do not require AC power to fulfill safety-related functions and the onsite electric AC power systems are not safety related. The EDSS conforms to RG 1.32. RG 1.32 is not applicable to the offsite and onsite AC power systems. The EDSS conforms to RG 1.32 to the extent described in Section 8.3.	8.2 8.3
1.33	Quality Assurance Program Requirements (Operation)	3	Not Applicable	Not Applicable	The NuScale certified design effort is being conducted under a QA program that implements the QA standards of NQA-1-2008/1a-2009, as endorsed by RG 1.28, Revision 4. It is anticipated and assumed that COL applicants referencing the NuScale design similarly will apply NQA-1-2008/1a-2009, consistent with the QAPD to be described in the DCA. The NRC is currently reviewing NEI 11-04, draft Revision 0, which provides guidance for developing a QAPD that implements NQA-1-2008/1a-2009 and RG 1.28, Revision 4. As detailed in Appendix 1 of NEI 11-04, the substantive content of RG 1.33 is subsumed into NQA-1-2008/1a-2009 (with modifications described in RG1.28) and NEI1104. Thus, implementation of NQA-1-2008/1a-2009 (with modifications described in RG1.28) and NEI 11-04 would ensure that the substantive content of RG 1.33 is satisfied.	Not Applicable
1.34	Control of Electroslag Weld Properties	1	Conforms	Applicable	None.	5.2 5.3 5.4
1.35	Inservice Inspection of UngROUTED Tendons in Prestressed Concrete Containments	3	Not Applicable	Not Applicable	The containment vessel is a steel containment (i.e., does not use concrete, prestressed or other, in its design).	Not Applicable

Table 8.1-1: Acceptance Criteria and Guidelines for Electric Power Systems

Criteria	Title	Applicable Section (Note 1)				Remarks
		8.2 Offsite Power System	8.3.1 Onsite AC Power System	8.3.2 Onsite DC Power System	8.4 Station Blackout	
1. 10 CFR 50, Appendix A, General Design Criteria for Nuclear Plants						
a. GDC 2	Design bases for protection against natural phenomena		A	A		§8.2 - ADAMS Accession No. ML090260039
b. GDC 4	Environmental and dynamic effects design bases		A	A		§8.2 - ADAMS Accession No. ML090260039
c. GDC 5	Sharing of structures, systems, and components		A	A		§8.2 - ADAMS Accession Nos. ML11133A334 and ML090260039
d. GDC 17	Electric power systems					The NuScale design supports an exemption from GDC 17.
e. GDC 18	Inspection and testing of electric power systems					The NuScale design supports an exemption from GDC 18.
f. GDC 33	Reactor coolant makeup					The NuScale design supports an exemption from GDC 33.
g. GDCs 34, 35, 38, 41, 44	Residual heat removal, emergency core cooling, containment heat removal, containment atmosphere cleanup, cooling water					The plant design complies with a set of principal design in lieu of these GDC, as described in Section 3.1.4.
h. GDC 50	Containment design basis					Containment vessel penetration assemblies are not included in the scope of the onsite electrical power system. Penetration assemblies are part of the containment design.
2. Regulations (10 CFR 50 and 10 CFR 52)						
a. 10 CFR 50.34	Contents of applications; technical information					
i. 10 CFR 50.34(f)(2)(v)	Additional Three Mile Island (TMI)-related requirements (Item I.D.3)		A	A		
ii. 10 CFR 50.34(f)(2)(xiii)	Additional TMI-related requirements (Item II.E.3.1)					The NuScale design supports an exemption from 10CFR50.34(f)(2)(xiii).

Table 8.1-1: Acceptance Criteria and Guidelines for Electric Power Systems (Continued)

Criteria	Title	Applicable Section (Note 1)				Remarks
		8.2 Offsite Power System	8.3.1 Onsite AC Power System	8.3.2 Onsite DC Power System	8.4 Station Blackout	
iii. 10 CFR 50.34(f)(2)(xx)	Additional TMI-related requirements (Item II.G.1)					The NuScale design does not include pressurizer relief valves or block valves, and the the design supports an exemption from the pressurizer level indicator portion of 10CFR50.34(f)(2)(xx).
b. 10 CFR 50.55a(h)	Codes and standards		A	A		
c. 10 CFR 50.63	Loss of all alternating current power		G		A	
d. 10 CFR 50.65(a)(4)	Requirements for monitoring the effectiveness of maintenance at nuclear power plants	GA	A	A		Development and implementation of the Maintenance Rule program is discussed in Section 17.6.
e. 10 CFR 52.47(b)(1)	Contents of applications; technical information	A	A	A	A	Paragraph (b)(1), as it relates to ITAAC (for design certification) sufficient to assure that the SSCs in this area of review will operate in accordance with the certification.
f. 10 CFR 52.80(a)	Contents of applications; additional technical information					N/A for NuScale, this rule pertains to applications referencing an early site permit or a standard design certification.
3. Regulatory Guides (RGs)						
a. Regulatory Guide 1.6 - March 1971	Safety Guide 6 - Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems		G	G		
b. Regulatory Guide 1.32 - Revision 3, March 2004	Criteria for Power Systems for Nuclear Power Plants	G	G	G		As it relates to the EDSS; see Section 8.3.2
c. Regulatory Guide 1.47 - Revision 1, February 2010	Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems		G	G		As it relates to the EDSS; see Section 8.3.2
d. Regulatory Guide 1.53 - Revision 2, November 2003	Application of the Single-Failure Criterion to Safety Systems		G	G		As it relates to the EDSS; see Section 8.3.2

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

eRAI No.: 8823

Date of RAI Issue: 05/26/2017

NRC Question No.: 08.02-5

DSRS Section 8.2 states that acceptable guidelines for the design, installation, testing, and performance of station grounding systems and surge and lightning protection systems are found in: 1) RG 1.204, "Guidelines for Lightning Protection of Nuclear Power Plants"; 2) IEEE Std. 665-1995, "IEEE Guide for Generating Station Grounding"; 3) IEEE Std. 666-1991, "IEEE Design Guide for Electric Power Service Systems for Generating Stations"; 4) IEEE Std. 1050-1996, "IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations"; and 5) IEEE Std. C62.23-1995, "IEEE Application Guide for Surge Protection of Electric Generating Plants." DSRS Table 8-1, "Acceptance Criteria and Guidelines for Electric Power Systems," states that RG 1.204 is used as guidance for Section 8.2 on offsite power systems.

FSAR Tier 2 Table 8.1-1, "Acceptance Criteria and Guidelines for Electric Power Systems" states that RG 1.204 does not apply for FSAR Tier 2 Section 8.2 on offsite power systems. However, FSAR Tier 2, Table 1.9-2, "Conformance with Regulatory Guides," states that "The grounding and lightning protection systems are designed, installed, tested, and maintained in conformance with RG 1.204, with the exception that where IEEE Std. 666-1991 (Reaffirmed 1996) and IEEE Std. 1050-1996 are specified, IEEE Std. 666-2007 and IEEE Std. 1050-2004 instead are applied. Reconciliation of the two versions of each standard demonstrates the acceptability of the use of the later versions."

FSAR Tier 2 Section 8.2.2, "Switchyard," includes in COL Item 8.2-1 that a COL applicant that references the NuScale Power Plant design certification will describe the site-specific switchyard and design, including lightning and grounding equipment.

The staff requests NuScale to please explain why the grounding and lightning protection of the switchyard and connections to an offsite and onsite power system does not meet the guidance in RG 1.204 and the applicable standards listed in the above paragraph, as discussed in DSRS Section 8.2. If the grounding and lightning protection of the switchyard and connections to an offsite and onsite power system does meet the guidance in RG 1.204, please clarify FSAR Tier 2 Section 8.2 to state conformance to RG 1.204.

NuScale Response:

NuScale has requested an exemption from GDC 17 as described in FSAR Section 8.2.3.2. Accordingly, FSAR Table 1.9-3 identifies a difference in design features and procedural measures described in NuScale DSRS Chapter 8.2, Offsite Power System, including Acceptance Criterion II.2 as addressed by Review Procedure III.3. Part III.3.1 of the DSRS addresses systems for grounding, surge protection, and lightning protection. As stated in Section III.3 of the DSRS, this part is one of several review steps that would be performed "to verify the requirements of GDC 17 are satisfied." Consistent with the requested exemption from GDC 17, the NuScale offsite power system design does not conform with Acceptance Criterion II.2 or Review Procedure III.3.

The NuScale design does not rely on an electric power grid connection and grid stability for safe operation, consistent with the discussion of passive plants within Part III.3.F of DSRS Chapter 8.2. An offsite power system is an optional system for the NuScale Power Plant that is not credited for mitigating any design basis event, is not required to perform risk-significant functions, and does not power any Class 1E loads, as described in FSAR Section 8.2. An offsite power system, if provided within a site-specific COL application, is also not a preferred power system as used in the discussion of lightning discharges included in DSRS Chapter 8.2 Part I.6. "Preferred power system" is a term that does not apply to the NuScale design.

For site-specific COL plant designs that include an offsite power system, COL Item 8.2-1 states that the COL applicant will describe lightning and grounding protection. The design of this equipment would be consistent with good engineering practice and consistent with IEEE design standards as they may apply to switchyards that serve nonsafety-related electrical equipment that is not risk-significant. The design of the switchyard and connections would not be required to show compliance with RG 1.204 or industry standards in order to demonstrate compliance with GDC 17 for a preferred power system or to assure nuclear safety. Due to the differences in the actual NuScale Power Plant design features versus corresponding features addressed by NuScale DSRS Chapter 8.2, the grounding and lightning protection guidance of DSRS Chapter 8.2 does not apply to the offsite power system.

The design of the grounding and lightning protection for the onsite ac power systems is described in Section 8.3.1.2.4, which addresses compliance with RG 1.204 and the associated IEEE standards. Section 8.3.1 is consistent with the RG 1.204 entry in Table 1.9-2, Conformance with Regulatory Guides, which does not include Section 8.2, Offsite Power System, as applicable.

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.: 8823

Date of RAI Issue: 05/26/2017

NRC Question No.: 08.02-6

Generic (GL) Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," (ADAMS Accession No. ML070360665) and the associated Summary Report (ADAMS Accession No. ML082760385) discuss cable failures, and finds that: 1) the predominant factor contributing to cable failures at nuclear power plants appears to be the presence of water/moisture or exposed to submerged conditions, and 2) licensees should have a program for using available diagnostic cable testing methods to assess cable condition.

DSRS Section 8.2 states that operating experience has shown that undetected degradation of underground electric cables due to protracted exposure to wetted environments or submergence in water could result in multiple equipment failures and cables from independent power sources or different divisions could be affected by the same condition.

The staff requests NuScale to;

1. Please explain how the NuScale design addresses the operating experience in GL 2007-01, and
 2. Identify if there are any inaccessible or underground cables, and if there are any inaccessible or underground cables, describe the inspection, testing and monitoring programs, if applicable, to detect the degradation of inaccessible or underground cables. If condition monitoring programs are used, discuss the applicability of RG 1.218, "Condition Monitoring Techniques for Electric Cables Used in Nuclear Power Plants" for the offsite power system.
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NuScale Response:

Question 1 Response

The NuScale design partially conforms to GL 2007-01. The letter states that environmental failures of certain power cables can affect the functionality of accident mitigation systems and can disable risk-significant equipment. The letter also addresses the need to include environmental conditions in the design of cables that connect offsite power to safety buses, cables that connect an EDG to a safety bus, and cables that provide power to active emergency



core cooling support systems. The power cables within the scope of FSAR Chapter 8 are not used in these applications, and this portion of GL 2007-01 is not applicable to these cables as further explained below.

The letter cites GDC 17 and GDC 18 as applicable regulatory requirements to justify cable inspection, testing, and monitoring. NuScale has requested an exemption from GDC 17 and GDC 18 as described in FSAR Section 8.2.3.2. Accordingly, FSAR Table 1.9-3 identifies a difference in design features and procedural measures described in NuScale DSRS Chapter 8.2, including Acceptance Criterion II.2 as addressed by Review Procedure III.3. Part III.3.L of the DSRS addresses underground or inaccessible cables connecting offsite power to safety buses or equipment with accident mitigating functions. This part is one of several review steps that would be performed "to verify the requirements of GDC 17 are satisfied," as stated in Section III.3 of the DSRS. Consistent with the requested exemption from GDC 17, the NuScale design does not conform with Acceptance Criterion II.2 and Review Procedure III.3.

The NuScale design does not rely on the offsite power system for safe operation, consistent with the discussion of passive plants within Part III.3.F of NuScale DSRS Chapter 8.2. An offsite power system is an optional system for the NuScale Power Plant that is not credited for mitigating any design basis event, is not required to perform risk-significant functions, and does not power any Class 1E loads, as described in FSAR Section 8.2. Due to these differences in the actual NuScale Power Plant design features versus corresponding features addressed by NuScale DSRS Chapter 8.2, the guidance of DSRS Part III.3.L does not apply to the offsite power system.

The portion of GL 2007-01 that is applicable to the NuScale design is the cable monitoring that may be required to meet 10 CFR 50.65. As described in FSAR Section 17.6, a COL applicant will describe the program for monitoring the effectiveness of maintenance required by 10 CFR 50.65.

Question 2 Response

The routing of cables for the offsite power system is a site-specific activity. The detailed design phase will determine if any offsite power cables are within the scope of 10 CFR 50.65 and are located in underground or inaccessible environments that may result in the cable degradation mechanisms described in GL 2007-01. The COL holder will implement condition monitoring for these cables in accordance with Regulatory Guide 1.218 (April 2012).

NuScale conformance with RG 1.218 is described in FSAR Section 8.3.1.2.7 for the onsite ac power systems and in FSAR Section 8.3.2.2.2 for the dc power systems. These sections are consistent with the discussion above. The same statement of conformance with RG 1.218 has been added to FSAR Section 8.2.3.2 for the offsite power system. FSAR Table 8.1-1, Acceptance Criteria and Guidelines for Electric Power Systems, has been revised to include a "G" to indicate that the guidance of RG 1.218 is applicable to the offsite power system.

NuScale has also identified conforming changes to other sections of the FSAR. The comment



section for the RG 1.218 entry in FSAR Table 1.9-2, Conformance with Regulatory Guides, and FSAR Table 1.9-6, Evaluation of Operating Experience (Generic Letters and Bulletins), have been revised to add clarity, consistent with the response to the questions above.

Impact on DCA:

FSAR Tables 1.9-2, 1.9-6, 8.1-1 and FSAR Section 8.2.3.2 have been revised as described in the response above and as shown in the markup provided in this response.

Table 1.9-2: Conformance with Regulatory Guides

RG	Division Title	Rev.	Conformance Status	COL Applicability	Comments	Section
1.3	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors	2	Not Applicable	Not Applicable	This guidance is only applicable to BWRs.	Not Applicable
1.4	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors	2	Not Applicable	Not Applicable	This RG pertains to existing reactors; RG 1.183 is specified in SRP Section 15.0.3 to be used for new reactors.	Not Applicable
1.5	Safety Guide 5 - Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors	-	Not Applicable	Not Applicable	This guidance is only applicable to BWRs.	Not Applicable
1.6	Safety Guide 6 - Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems	-	Partially Conforms	Applicable	The onsite electrical AC power systems do not contain any Class 1E distribution systems. The EDSS design conforms to the guidance for independence of standby power sources and their distribution systems.	8.3
1.7	Control of Combustible Gas Concentrations in Containment	3	Not Applicable	Not Applicable	The containment vessel design is such that its integrity does not rely on combustible gas control systems.	6.2
1.8	Qualification and Training of Personnel for Nuclear Power Plants	3	Not Applicable	Applicable	Site-specific programmatic and operational activities are the responsibility of the COL applicant.	Not Applicable
1.9	Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants	4	Not Applicable	Not Applicable	Based on reduced reliance on AC power, the design does not require or include safety-related emergency diesel generators.	8.3
1.11	Instrument Lines Penetrating the Primary Reactor Containment	1	Not Applicable	Not Applicable	No lines penetrate the NPM containment.	6.2

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

RG	Division Title	Rev.	Conformance Status	COL Applicability	Comments	Section
1.218	Condition-Monitoring Techniques for Electric Cables Used in Nuclear Power Plants	-	Not Applicable	Applicable	This guidance governs electric cable monitoring program activities that are not within the scope of design certification. Rather, these activities are the responsibility of and applicable to operating reactor licensees, including COL holders. The COL holder determines whether a cable is subject to condition monitoring during the development of the maintenance rule (10 CFR 50.65) program. This includes identification of SSC that require assessment per 10 CFR 50.65(a)(4). Cables that meet the criteria for inclusion in the maintenance rule program are subject to the guidance of RG 1.218.	Not Applicable 8.1 8.2 8.3
1.219	Guidance on Making Changes to Emergency Plans for Nuclear Power Reactors	-	Not Applicable	Applicable	These requirements are applicable to operating reactor licensees, including COL holders.	Not Applicable
1.221	Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants	-	Conforms	Applicable	NuScale uses Region 1 (bounding) characteristics as design parameters.	3.3 3.5 3.8
1.226	Flexible Mitigation Strategies for Beyond-Design-Basis Events (Draft DG-1301)	-	Partially Conforms	Applicable	The RG, presently in draft, endorses, with clarifications, NEI 12-06 Rev 1A, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide. NuScale is writing Chapter 20 meeting the applicable portions of the draft guidance. There is guidance in NEI 12-06 that is not applicable the NuScale design. These items are addressed in Chapter 20.	Ch 20
1.227	Wide-Range Spent Fuel Pool Level Instrumentation (Draft DG-1317)	-	Conforms	Applicable	The RG, presently in draft, endorses, with exceptions and clarifications, NEI 12-02 Rev 1, Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation. NuScale is writing Chapter 20 meeting the applicable portions of the draft guidance. Spent fuel pool level instrumentation is addressed in Chapter 9.	Ch 20 9.2

Table 1.9-6: Evaluation of Operating Experience (Generic Letters and Bulletins)

Doc ID	Title	Conformance Status	COL Appl.	Comments	Section
Generic Letter 88-14	Instrument Air Supply System Problems Affecting Safety-Related Equipment	Conforms	Applicable	The IAS furnishes both instrument and service air. IAS moisture separators and dryer packages ensure that the instrument air supplied is dry in accordance with the quality standards of ANS/ISA S7.3-R1981.	9.3.1
Generic Letter 88-15	Electric Power Systems - Inadequate Control Over Design Processes	Partially Conforms	Applicable	Portions relevant to the NuScale passive plant design are considered in the design of electrical systems.	8.1.4 8.3.1 8.3.2
Generic Letter 91-06	Resolution of Generic Issue A30, Adequacy Of Safety-Related DC Power Supplies Pursuant to 10 CFR 50.54(f)	Partially Conforms	Applicable	No safety-related DC systems; however, relevant portions are considered in the design of the non-Class 1E EDSS.	8.1.4 8.3.2
Generic Letter 96-01	Testing of Safety-Related Logic Circuits	Conforms	Applicable	None.	7.2.2 7.2.15 8.1.4
Generic Letter 2006-02	Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power	Not Applicable	Applicable	The NuScale Power Plant does not rely on offsite power for safety-related or risk-significant functions. Grid stability studies are the responsibility of a COL applicant that references the NuScale design certification.	8.2.1 8.2.3
Generic Letter 2007-01	Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients.	Partially Conforms	Applicable	Portions relevant to the NuScale passive plant design are considered in the design of electrical systems. <u>As described in Chapter 8, the electrical power systems do not include power cables that provide power to equipment with risk-significant or safety-related functions. The scope of compliance with the issues addressed by GL 2007-01 is limited to power cables within the scope of 10 CFR 50.65. Conformance is achieved for cable monitoring by the COL holder applying the guidance of RG 1.218 as discussed in Chapter 8.</u>	8.1.4 8.2.1 8.3.18.1 <u>8.2 8.3</u>

Table 8.1-1: Acceptance Criteria and Guidelines for Electric Power Systems

Criteria	Title	Applicable Section (Note 1)				Remarks
		8.2 Offsite Power System	8.3.1 Onsite AC Power System	8.3.2 Onsite DC Power System	8.4 Station Blackout	
1. 10 CFR 50, Appendix A, General Design Criteria for Nuclear Plants						
a. GDC 2	Design bases for protection against natural phenomena		A	A		§8.2 - ADAMS Accession No. ML090260039
b. GDC 4	Environmental and dynamic effects design bases		A	A		§8.2 - ADAMS Accession No. ML090260039
c. GDC 5	Sharing of structures, systems, and components		A	A		§8.2 - ADAMS Accession Nos. ML11133A334 and ML090260039
d. GDC 17	Electric power systems					The NuScale design supports an exemption from GDC 17.
e. GDC 18	Inspection and testing of electric power systems					The NuScale design supports an exemption from GDC 18.
f. GDC 33	Reactor coolant makeup					The NuScale design supports an exemption from GDC 33.
g. GDCs 34, 35, 38, 41, 44	Residual heat removal, emergency core cooling, containment heat removal, containment atmosphere cleanup, cooling water					The plant design complies with a set of principal design in lieu of these GDC, as described in Section 3.1.4.
h. GDC 50	Containment design basis		A	A		Containment vessel penetration assemblies are not included in the scope of the onsite electrical power system. Penetration assemblies are part of the containment design. <u>The electrical design requirements for electrical penetration assemblies are included in Section 8.3.1.</u>
2. Regulations (10 CFR 50 and 10 CFR 52)						
a. 10 CFR 50.34	Contents of applications; technical information					
i. 10 CFR 50.34(f)(2)(v)	Additional Three Mile Island (TMI)-related requirements (Item I.D.3)		A	A		

Table 8.1-1: Acceptance Criteria and Guidelines for Electric Power Systems (Continued)

Criteria	Title	Applicable Section (Note 1)				Remarks
		8.2 Offsite Power System	8.3.1 Onsite AC Power System	8.3.2 Onsite DC Power System	8.4 Station Blackout	
p. Regulatory Guide 1.204 - November 2005	Guidelines for Lightning Protection of Nuclear Power Plants		G			
q. Regulatory Guide 1.206 - June 2007	Combined License Applications for Nuclear Power Plants (LWR Edition)	G	G	G	G	
r. Regulatory Guide 1.212 - November 2008	Sizing of Large Lead-Acid Storage Batteries			G		As it relates to sizing VRLA batteries; see Section 8.3.2
s. Regulatory Guide 1.218 - April 2012	Condition-Monitoring Techniques for Electric Cables Used in Nuclear Power Plants	<u>G</u>	G	G		Limited to cables determined to be within the scope of 10 CFR 50.65
4. Branch Technical Positions (BTPs)						
a. SRP BTP 8-1	Requirements on Motor-Operated Valves in the ECCS Accumulator Lines					Not applicable; no safety-related MOVs or ECCS accumulator lines in the NuScale design
b. SRP BTP 8-2	Use of Onsite AC Power Sources for Peaking		G			As it relates to the non-Class 1E BDGs; see Section 8.3.1
c. SRP BTP 8-3	Stability of Offsite Power Systems	G				
d. SRP BTP 8-4	Application of the Single Failure Criterion to Manually-Controlled Electrically-Operated Valves					Not applicable; see Section 8.3.1 and Section 8.3.2
e. SRP BTP 8-5	Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features Systems		G	G		See Section 8.3.1.2 and Section 8.3.2.2
f. SRP BTP 8-6	Adequacy of Station Electric Distribution System Voltages (for Passive Design)	G	G			<u>Not applicable; See Section 8.2.3 and Section 8.3.1</u>
g. SRP BTP 8-7	Criteria for Alarms and Indications Associated with Diesel-Generator Unit Bypassed and Inoperable Status					Not applicable; no Class 1E emergency diesel generators
h. SRP BTP 8-8	Onsite (emergency diesel generators) and offsite power sources allowed outage time extensions					Not applicable; with non-reliance on AC power, no technical specification operating restrictions for inoperable AC power sources
i. SRP BTP 8-9	Open Phase Conditions in Electric Power System	G	G			See Section 8.2

unit on the grid, the loss of one NuScale Power Module, and the loss of the full complement of NuScale Power Modules (up to 12). The study will be performed in accordance with the applicable Federal Energy Regulatory Commission, North American Electric Reliability Corporation, and transmission system operator requirements, including communication agreements and protocols.

8.2.3.2 Analysis of Offsite Power System Conformance with Regulatory Framework

This section describes the extent to which the design of the offsite power system conforms to NRC requirements and guidance.

General Design Criteria 17

The NuScale design supports an exemption from the GDC 17 requirements for an offsite power system. The passive design of the NuScale Power Plant does not rely on onsite AC power and does not require an offsite power system to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences or to maintain core cooling or containment integrity in the event of postulated accidents, as discussed in Section 15.0.0. In addition, the offsite power system is not relied upon to provide power for risk-significant functions.

General Design Criteria 18

As described above, the NuScale design supports an exemption from GDC 17. Accordingly, the design supports an exemption from the GDC 18 inspection and testing requirements.

General Design Criteria 33

The NuScale design supports an exemption from GDC 33, as described in Section 3.1.4.

General Design Criteria 34, 35, 38, 41, and 44

The plant design complies with a set of principal design criteria in lieu of these GDC, as described in Section 3.1.4. The principal design criteria do not include requirements for electric power systems.

10 CFR 50.63

The NuScale Power Plant conformance with 10 CFR 50.63 is described in Section 8.4.

10 CFR 50.65(a)(4)

The development and implementation of the maintenance rule (10 CFR 50.65) program, including the identification of structures, systems, and components that require assessment in accordance with 10 CFR 50.65(a)(4), is described in Section 17.6.

Regulatory Guide 1.218 (April 2012)

Regulatory Guide 1.218 provides guidance for monitoring the condition of cables that have been determined to fall within the scope of the maintenance rule (10 CFR 50.65). The development and implementation of the maintenance rule program, including the identification of SSC that require assessment per 10 CFR 50.65(a)(4), is stated in Section 17.6.

Branch Technical Position 8-3 Revision 3

The performance of grid stability studies is site-specific and is addressed in Section 8.2.3.1.

Branch Technical Position 8-6 Revision 3

Branch Technical Position (BTP) 8-6 addresses the adequacy of offsite system voltages to Class 1E (safety-related) loads. The offsite power system does not supply power to Class 1E loads and does not support safety-related functions. Accordingly, BTP 8-6 is not applicable to the offsite power system.

Branch Technical Position 8-9 Revision 0

The BTP 8-9 addresses the effects of transmission grid open-phase conditions as identified in NRC Information Notice 2012-03 and NRC Bulletin 2012-01. This guidance involves protection from a common cause AC power failure due to open phase conditions in the offsite power sources that are credited for GDC 17 and the effect on onsite safety-related buses and safety-related loads. The offsite power system does not support safety-related functions. In addition, there are no failures of the offsite power system, including open phase conditions or a station blackout, that will prevent the operation of safety-related functions.

If the offsite power system is supplying power to the onsite AC power system, the electrical isolation between the highly reliable DC power system and equipment with safety-related functions, which is described in Section 7.1.2, ensures that the open phase conditions described in BTP 8-9 would not prevent the performance of safety-related functions.

Regulatory Guide 1.32 Revision 3

Regulatory Guide 1.32 addresses design criteria for safety-related power systems. The NuScale Power Plant does not rely on an offsite power system to support or perform safety functions. Accordingly, Regulatory Guide 1.32 is not applicable to the offsite power system.

Regulatory Guide 1.68 Revision 3

COL Item 8.2-3: A COL applicant that references the NuScale Power Plant design certification will describe the testing of the switchyard and the connections to an offsite power system, if provided, consistent with Regulatory Guide 1.68, Revision 3.

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

eRAI No.: 8823

Date of RAI Issue: 05/26/2017

NRC Question No.: 08.02-7

Recognizing that the NuScale design has the flexibility to be connected to a transmission grid, micro-grid or dedicated service load, staff is addressing connections to offsite power sources.

FSAR Tier 2 Table 8.1-1, "Acceptance Criteria and Guidelines for Electric Power Systems" states that SRP BTP 8-9 and BL 2012-01 are guidance for Section 8.2 regarding open phase conditions in the grid. FSAR Tier 2 Section 8.2 states that there are no failures of the offsite power system, including open phase conditions or a station blackout that will prevent the operation of safety-related functions.

Furthermore, FSAR Tier 2 Section 8.2 states that "If the offsite power system is supplying power to the onsite AC power system, the electrical isolation between the "highly reliable" DC power system and equipment with safety-related functions, which is described in [FSAR Tier 2] Section 7.1.2, ensures that the open phase conditions described in BTP 8-9 would not prevent the performance of safety-related functions."

DSRS Section 8.2 states that: 1) no single event, including a single protective relay, interlock, or switchgear failure, in the event of loss of all standby power sources, will prevent the separation of the offsite power system from the onsite distribution system and 2) the offsite power system and standby power supplies should not have common mode failures. In general, a failure modes and effects analysis (FMEA) for the offsite system evaluates the effects of failures including loss of a relay or switchgear and open phase event.

The staff requests additional detail and discussion or an FMEA regarding the offsite power system to clearly show that no failures of the offsite power system, including open phase conditions, will prevent the operation of safety-related functions. Operating experience described in Bulletin 2012-01 shows that open-phase conditions, if unattended/detected, can initiate electrical transient and/or sustained degraded voltage condition, which could potentially impact the electrical power system. Otherwise, provide features for detection of open phase conditions and alarm in the main control room, as specified in BTP 8-9, Position B.3 for designs with passive safety features.

NuScale Response:

NuScale understands the RAI question to refer, in part, to DSRS Section 8.2, Review Procedure 3.H. To clarify, that Review Procedure states that “no single event, including a single protective relay, interlock, or switchgear failure, in the event of loss of all standby power sources, will prevent the separation of the preferred power system from the onsite power distribution system or prevent the preferred power system from accomplishing its intended functions. In addition, the preferred and standby power supplies should not have common failure modes.” The review procedure continues “An acceptable design should be capable of restoring the preferred power supply after the loss of either circuit in a time period such that the plant can be safely shut down, taking into account the effects of a single failure in the onsite distribution system.” These reviews are performed in order to “[verify] that the preferred power system is independent of the onsite power system.”

The offsite power system, if provided, is not a preferred power system for the NuScale design. The preferred power system alluded to by the DSRS and SRP BTP 8-9 is the offsite power system typical of operating LWRs. While the RAI seeks to extend this review to NuScale’s offsite power system, the differences between a preferred power system as referenced by the DSRS and a potential offsite power system at a NuScale facility are more than nomenclature: because electric power is not required to perform any safety-related function in the NuScale design, offsite power is by definition not preferred for this purpose. NuScale does not seek to demonstrate conformance with Review Procedure 3.H for the offsite power system.

Notwithstanding the above, NuScale recognizes that an open phase condition (OPC) in the offsite power system during a design basis event is possible. An OPC was evaluated using the guidance of SRP BTP 8-9 as it applies to passive plants, although the lack of risk-significant or safety-related functions for the offsite power system and NuScale’s proposed exemption to GDC 17 obviate the need to demonstrate compliance with the stated design criteria of SRP BTP 8-9 Position B.3 as cited in Part 2 of the Technical Rationale for DSRS Section 8.2.

An AC equipment failure could occur due to an OPC that results in a faulted circuit and unbalanced voltage condition in the offsite power system. However an AC equipment failure, including a station blackout that fails all AC equipment, does not prevent operation of safety-related equipment, all of which are DC-powered (EDSS) and fail-safe. There are no credible EDSS failure modes, including charger and battery failures, that would prevent the fail-safe safety-related functions as described in FSAR Table 8.3-7, Highly Reliable Direct Current Power System Failure Modes and Effects Analysis. In addition, the plant design includes safety-related isolation devices between the EDSS and safety-related loads. As described in FSAR Section 7.1.2.2, the isolation is designed and tested to confirm that credible failures on the nonsafety side of the isolation device do not prevent the associated safety system(s) from meeting the minimum performance requirements.

The lack of safety-related or risk-significant loads on the offsite power system, the electrical isolation of DC-power from safety-related equipment, and the fail-safe design of the DC-



powered safety-related equipment itself ensures that an OPC in an offsite power system during a design basis event would not prevent the performance of any required safety-related functions.

Impact on DCA:

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