

September 26, 2017

MEMORANDUM TO: Samuel S. Lee, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Omid Tabatabai, Senior Project Manager */RA/*
Licensing Branch 1
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Office of New Reactors

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF REPORT FOR
THE AUDIT OF NUSCALE ENGINEERING REPORT, ER-D000-4318,
REVISION 0, "SAFETY CLASSIFICATION ASSESSMENT OF
NUSCALE PLANT ELECTRICAL SYSTEMS" (DOCKET NO. 52-048)

On June 28, 2017, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a regulatory audit of a document to facilitate the review of the NuScale Power, LLC (NuScale) Design Certification Application, Tier 2, Chapter 8, "Electric Power." Specifically, the staff audited NuScale engineering report, ER-D000-4318, Revision 0: "Safety Classification Assessment of NuScale Plant Electrical Systems."

The purpose of this audit was to obtain clarifications regarding (1) NuScale's approach for the safety classification of electrical systems, (2) the design, qualification, and quality assurance provisions that are applied to the "highly reliable" direct current system, and (3) the emergency lighting capability. The NRC staff conducted its audit of the above mentioned document on NuScale's electronic reading room and held a videoconference meeting with the NuScale technical staff on June 28, 2017.

The staff's audit plan, dated June 15, 2017, is available in the Agencywide Document Access and Management System (ADAMS) under Accession No. ML17163A189. The NRC staff conducted the audit in accordance with the Office of New Reactors (NRO) Office Instruction NRO-REG-108, "Regulatory Audits."

Docket No.: 52-048

Enclosure:
As stated

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SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF REPORT FOR THE AUDIT OF NUSCALE ENGINEERING REPORT, ER-D000-4318, REVISION 0, "SAFETY CLASSIFICATION ASSESSMENT OF NUSCALE PLANT ELECTRICAL SYSTEMS" (DOCKET NO. 52-048) DATED: 9/26/2017

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DATE	09/26/2017	09/13/2017	08/25/2017	09/26/2017

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SUMMARY OF STAFF AUDIT OF NUSCALE ENGINEERING REPORT, ER-D000-4318,
REVISION 0, “SAFETY CLASSIFICATION ASSESSMENT OF NUSCALE PLANT
ELECTRICAL SYSTEMS”

NRC AUDIT TEAM:

- Tania Martinez Navedo, Acting Chief, Electrical Engineering Branch
- Swagata Som, Audit Team Lead
- Sheila Ray, Senior Electrical Engineer
- Robert Fitzpatrick, Electrical Engineer
- Fanta Sacko, Electrical Engineer
- Omid Tabatabai, Senior Project Manager

1. SUMMARY

On June 28 2017, the U.S. Nuclear Regulatory Commission (NRC) staff from the Electrical Engineering Branch (EENB) conducted an audit of NuScale Document ER-D000-4318, Revision 0, “Safety Classification Assessment of NuScale Plant Electrical Systems.” This audit was conducted in support of the staff’s review of the NuScale Design Certification Application (DCA). The results from the audit will support the basis for licensing and regulatory decisions related to specific areas of Chapter 8, “Electrical Power,” of the NuScale DCA. This includes methods, key assumptions, and results that determined the safety classification of electrical systems. The NRC audit team also reviewed the document to ensure that analyses meet the regulatory guidance, and the Design Specific Review Standard (DSRS) related to NuScale Plant Design.

2. BACKGROUND AND SCOPE

NuScale Document ER-D000-4318 describes how the NuScale plant meets the “conditions of applicability,” as described in the topical report (TR) 0815-16497, “Safety Classification of Passive Nuclear Power Plant Electrical Systems,” and determination of the appropriate classification of NuScale plant electrical supply systems. The Revision 0 to this TR was submitted for the staff review in October 2015, which was prior to the submittal of the DCA in December 2016. The staff issued its public version of the safety evaluation report for the TR, Revision 1, on June 27, 2017, which is available in ADAMS under Accession No. ML17170A201.

NuScale Final Safety Analysis Report (FSAR) Tier 2, Section 8.1.1, “Utility Power Grid and Offsite Power System Description,” states that the NuScale Power Plant is designed with passive, safety-related systems for safe-shutdown, core and spent fuel assembly cooling, containment isolation and integrity, and reactor coolant pressure boundary integrity. Additionally, FSAR Tier 2, Section 8.1.3, “Safety-Related Loads,” states that the NuScale design includes no safety-related loads and does not rely on electrical power or operator action to achieve and maintain safe-shutdown. Thus, NuScale stated that there are no Class 1E power sources in the NuScale design.

Enclosure

The EENB staff reviewed document ER-D000-4318, which discusses how the NuScale plant design meets the “conditions of applicability” described in the TR and how the applicant determined the appropriate safety classification of NuScale plant electrical supply systems. The term “Conditions of Applicability”, as described in the TR, comprise a set of passive reactor plant design and operational attributes that, if met in full, justify the applicant’s determination that no plant electrical supply systems fulfil functions that would warrant a Class 1E classification. The “Conditions of Applicability” are presented in the TR in two separate categories in Section I and Section II of Table 3-1. These attributes must be fully satisfied towards a determination that its plant electrical system do not warrant a Class 1E classification. Furthermore, this document discusses the non-reliance on electrical power for safe-shutdown, core cooling, containment isolation and integrity, as stated in FSAR Tier 2, Chapter 8 of the DCA. The document ER-D000-4318 is an associated document that describes the methodology, procedure and key assumptions to determine that safety-related functions can be achieved without relying on Class 1E electric power during a design basis event (DBE).

The information reviewed in the audit provides direct support for the safety conclusions that apply to the NuScale DCA under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants”. Specifically, the information reviewed will provide support to the General Design Criterion (GDC) 17, “Electric Power Systems” and GDC 18, “Inspection and Testing of Electric Power Systems exemptions requested by NuScale. Furthermore, this information will be referenced in the staff’s Final Safety Evaluation Report on the methodology and assumptions of the NuScale DCA, regarding how the electrical systems meet the applicable regulations.

The scope of the staff’s audit included three items, as described in the NRC Audit Plan, and limited to electrical topics only:

1. Clarification of NuScale’s approach on the safety classification of electrical systems,
2. Clarification on the design, qualification, and quality assurance (QA) provisions that are applied to the direct current (DC) system (i.e. EDSS), and
3. Clarification on the emergency lighting capability.

3. REGULATORY BASIS

The regulatory basis for the staff review is as follows:

- 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants”
- 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities”, Appendix A, GDC 17
- 10 CFR Part 50, Appendix A, GDC 18
- NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition),” Chapter 8, “Electric Power”

- NuScale DSRS Chapter 8, “Electric Power”
- NUREG –0800, Section 9.5.3, “Lighting System”

4. OBSERVATIONS AND EVALUATIONS

The purpose of NuScale document ER-D000-4318 is to support the use of the TR as a basis for demonstrating that Class 1E electrical systems are not required in the NuScale design. Specifically, this report documents the ability of the NuScale plant design to meet the conditions of applicability as described in the TR and identification of open design items (ODI), if any, that require resolution prior to reaching a conclusion that all conditions of applicability are fully met by the NuScale plant design.

The applicant stated in document ER-D000-4318 that they performed a functional evaluation that demonstrated each “Condition of Applicability” is met by the plant design. During the audit, the applicant 1) described the pertinent plant design and operational details, 2) discussed the availability of completed reference documents such as system descriptions, drawings, and calculations, methodology, assumptions, and 3) discussed their evaluation with respect to each condition of applicability listed in Table 3-1 of the TR.

The applicant also discussed that the NuScale Design does not require electrical power for achieving safe-shutdown as described in Section 6, “Assessment”, of the document ER-D000-4318. The applicant stated in the document that they have analyzed the DBE (including Loss of Coolant Accident) and determined that the safe-shutdown is achievable without relying on electrical power. The staff verified that Document ER-D000-4318, Section 6.1.1, addressed the assessment to achieve the safe-shutdown and maintain the core cooling, containment isolation and integrity, and reactor pressure boundary integrity, within acceptable limits established for a DBE. The staff verified that since each of these functions are analyzed in Document ER-D000-4318, the applicant’s function-by-function assessment determined that no electrical power will be required for achieving the safety functions of the reactor during DBE.

The applicant mentioned that the Plant Lighting System (PLS) satisfies the guidance of SRP/DSRS Section 9.5.3, and that appropriate portions (i.e., main control room emergency lighting) are powered from “Highly Reliable” DC electrical power system (EDSS). In addition, FSAR Tier 1, Table 1.9-3, states that the PLS satisfies the guidance of SRP 9.5.3. NuScale FSAR Tier 2, Section 9.5.3, states that appropriate portions of lighting system, such as emergency lighting, are powered from EDSS. The applicant performed a “Failure Mode and Effects Analysis (FMEA), ER-D070-4914, which the applicant stated demonstrates the capability of the PLS to fulfil its mission following any failure of a single PLS component. At the time of the audit, the applicant identified this as an open design item, ODI-16-0998. Subsequently, the applicant completed the FMEA and closed out ODI-16-0998. In Section 6.1.6 of ER-D000-4318, the applicant stated that the emergency lighting system and its electrical supplies incorporate significant redundancy and reliability features that provide reasonable assurance that the emergency lighting system is available and operable if needed. These features include measures that SRP Section 9.5.3, RG 1.189, and NUREG-0700 specify that should be used as a basis for demonstrating acceptable emergency lighting capability for NuScale plant design. The staff further verified that the applicant resolved ODI-16-0998 via an Engineering Change Order (ECO) for Resolved ODIs ER-D000-4318, R0, dated August 4, 2017, related to the plant lighting system. The applicant stated that design documents were updated with no change to

the assumption. Based on the above discussions and close-out of the ODI, the staff accepts the methodology and the assumptions of the classification of emergency lighting system of the PLS as described in ER-D000-4318.

The staff reviewed the document ER-D000-4318, Section 6.2.1, "Augmented Requirements," which describes the augmented design, qualification, and QA provisions of the EDSS as specified in Table 3-2, "Augmented design, qualification, and quality assurance provisions," of the TR-0815-16497. The staff noted that for each of the design provisions applied to the EDSS system, as listed in TR Table 3-2, supporting design information is available as references in Section 1.4 of document ER-D000-4318. These augmented provisions, as listed in Condition of Applicability Item II.1 of the TR, are applied as requirements to the EDSS including both EDSS-MS (module-specific) and EDSS-C (common for all modules) subsystems. The EDSS power is defined as "Highly Reliable" as this power will be used as an acceptable alternative to RG 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," portion of the post-accident monitoring instrumentation for Type B and Type C variables.

The staff reviewed the above design considerations applied to the non-Class 1E EDSS system toward an augmentation of the design to deem the system as "Highly Reliable." The staff accepts the methodology and the assumptions of the classification of EDSS system as non-Class 1E, as described in the document ER-D000-4318. Based on the above description of a non-Class 1E DC system, the staff verified the methodology and assumptions for the assessment of the EDSS system, pending resolution of the DC System specific questions related to DCA, in FSAR Tier 2, Section 8.3.2.

5. CONCLUSION

The staff evaluated 1) NuScale's approach on the safety classification of electrical systems, 2) design, qualification, and quality assurance provisions that are applied to the DC system (i.e. EDSS), and 3) the emergency lighting capability. Furthermore, the NRC staff 1) examined and evaluated classification basis, methodology, assumptions, procedures, and technical information, and 2) verified that supporting documentation are available with no Open Design Issue (ODI) related to specific areas of Chapter 8, "Electric Power," and Section 9.5.3, "Lighting System," of the NuScale design as discussed in Section 4 of this report.

The staff verified that the applicant's function-by-function assessment determined that no electrical power will be required for achieving the safety functions of the reactor during DBE. The staff verified the methodology and assumptions for the assessment of the safety classification of the EDSS system, pending resolution of the DC System specific questions related to DCA, in FSAR Tier 2, Section 8.3.2.

The staff accepts the methodology and the assumptions of the classification of emergency lighting system of the PLS as described in ER-D000-4318. As discussed in Section 4 of this report, the staff reviewed applicant's methodology of assessment of classification of electrical systems, and finds that the specific documentation reviewed meets the applicable regulations.