8 ELECTRIC POWER

8.1 Electric Power—Introduction

This chapter of the safety evaluation report (SER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's (hereinafter referred to as the staff) review of Chapter 8, "Electric Power," of the NuScale Power, LLC (hereinafter referred to as NuScale or the applicant), Standard Design Approval Application (SDAA), Part 2, "Final Safety Analysis Report" (FSAR). NuScale submitted this SDAA for its small modular reactor (SMR) standard plant design. The staff's regulatory findings documented in this SER are based on Revision 2 of the SDAA, dated April 9, 2025 (Agencywide Documents Access and Management System Accession No. ML25099A237).

Chapter 8 of the SDAA includes the FSAR for Section 8.1, "Introduction"; Section 8.2, "Offsite Power System"; Section 8.3, "Onsite Power Systems"; and Section 8.4, "Station Blackout."

The staff reviewed the design of the electric power systems that are necessary for the safe design and operation of the plant, or whose failure might adversely affect their safety-related functions, in accordance with the applicable design-specific review standards (DSRS) or NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), as applicable, and consistent with the graded review approach described in SER Section 1.9. SER Section 8.1.1 contains the introduction for the SDAA review of SDAA Chapter 8, and Sections 8.1, 8.2, 8.3.1, 8.3.2, and 8.4 contain the staff's technical evaluations and conclusions based on this review.

In this chapter, the staff uses the term "not safety related" to refer to certain structures, systems and components (SSCs) that do not fall under the definition of "safety-related SSCs" in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.2, "Definitions." Section 50.2 defines safety-related SSCs as those SSCs that are relied upon to remain functional during and following design basis events to assure: (1) The integrity of the reactor coolant pressure boundary, (2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of 10 CFR Chapter I, as applicable. The electrical systems are typically classified as Class 1E or non-Class 1E, as defined by Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 308-2020, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," and endorsed by Regulatory Guide (RG) 1.32.

IEEE Std. 308-2020, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," defines Class 1E as the safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal or that are otherwise essential in preventing a significant release of radioactive material to the environment. The NRC staff endorsed IEEE Std. 308-2020 in Regulatory Guide (RG) 1.32, "Criteria for Power Systems for Nuclear Power Plants." Furthermore, 10 CFR 50.49(b)(1) has a footnote that states that safety-related electric equipment is referred to as "Class 1E" equipment in IEEE Std. 323-1974, "IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations," as endorsed in RG 1.89, Revision 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants." RG 1.89 indicates that safety-related equipment is known as Class 1E. In this chapter, the staff refers to non-Class 1E equipment as not safety related.

The electric power system for the NuScale US460 design comprises a non-Class 1E alternating current (AC) power system and a non-Class 1E direct current (DC) power system. Non-Class 1E and non-risk-significant electric power systems for NuScale include normal AC and DC power systems that supply plant loads during startup and shutdown, normal operation, and off-normal conditions. The NuScale US460 design does not depend on, and therefore does not use or include, a Class 1E emergency onsite (AC or DC) power system.

The staff reviewed the non-Class 1E and non-risk-significant electric power systems (1) to verify that their failure will not prevent safe shutdown of the plant or result in an unacceptable release of radioactivity to the environment and (2) for compliance with the applicable requirements and conformance to the relevant guidance.

The SSCs are classified according to nuclear safety classification, seismic category, and quality group. FSAR Section 3.2, “Classification of Structures, Systems, and Components,” discusses the safety and risk significance of SSCs and provides the safety and risk categorization of SSCs for the NuScale US460 design. SER Sections 3.2 and 17.4 include further evaluation of the classification of SSCs. As discussed in SER Section 3.2, a category “B2” designation is given to SSCs that are determined to be both not safety related and not risk significant. FSAR Table 8.3-2, “Classification of Structures, Systems, and Components,” lists the classifications for onsite electrical power systems. This list identifies the electrical main equipment and auxiliary systems located in various areas of the power plant (i.e., the switchyard, batteries and chargers, backup power supplies, , and other such systems) as category B2. SER Section 19.1 describe and further evaluate the acceptability of the electrical systems’ safety-significance and risk-significance categorizations.

8.1.1 Introduction

The NuScale Power Plant standard design is modular with six nuclear power modules (NPMs). It is passive and has safety-related systems for safe shutdown, core and spent fuel assembly cooling, containment isolation and integrity, and reactor coolant pressure boundary (RCPB) integrity. Safe operation of this design does not depend on onsite or offsite AC or DC electric power, including that from the transmission grid. An auxiliary AC power source may also provide power to the plant. The onsite electric power system includes AC power systems and DC power systems and a backup power supply system (BPSS) consisting of backup diesel generators.

SER Sections 8.2, 8.3.1, and 8.3.2 discuss and evaluate the offsite and onsite power systems. The applicant addressed station blackout (SBO), defined as a complete loss of offsite and onsite AC power with a turbine trip. The NuScale passive plant design does not rely on the use of offsite or onsite AC or DC power for the performance of the safety-related functions for any design-basis event (DBE).

8.1.2 Technical Evaluation of Exemption Request

This section presents the NRC staff’s evaluation of the exemptions NuScale requested from General Design Criterion (GDC) 17, “Electric power systems,” and GDC 18, “Inspection and testing of electric power systems,” in Appendix A to 10 CFR Part 50 and the electric power provisions in GDC 33, 34, 35, 38, 41, and 44. It should be noted that the applicant has requested exemption for all provisions of GDC 33, however, only the electrical provisions are addressed in this chapter of the SE. Further provisions are discussed in the Chapter 9 SE.

GDC 17 requires the following:

> Electric power systems. An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.
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> The onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure.
>
> Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable. Each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded. One of these circuits shall be designed to be available within a few seconds following a loss-of-coolant accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.
>
> Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

GDC 18 requires the inspection and testing of electric power systems and states the following:

> Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems shall be designed with a capability to test periodically (1) the operability and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system.

GDC 33, “Reactor coolant makeup,” states the following:

> A system to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary shall be provided. The system safety

function shall be to assure that specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the reactor coolant pressure boundary and rupture of small piping or other small components which are part of the boundary. The system shall be designed to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished using the piping, pumps, and valves used to maintain coolant inventory during normal reactor operation.

GDC 34, “Residual heat removal,” states the following:

> A system to remove residual heat shall be provided. The system safety function shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the reactor coolant pressure boundary are not exceeded.
>
> Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

GDC 35, “Emergency core cooling,” states the following:

> A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.
>
> Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

GDC 38, “Containment heat removal,” states the following:

> A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.
>
> Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power

is not available) the system safety function can be accomplished, assuming a single failure.

GDC 41, “Containment atmosphere cleanup,” states the following:

> Systems to control fission products, hydrogen, oxygen, and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents, and to control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained.
>
> Each system shall have suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) its safety function can be accomplished, assuming a single failure.

GDC 44, “Cooling water,” states the following:

> A system to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided. The system safety function shall be to transfer the combined heat load of these structures, systems, and components under normal operating and accident conditions.
>
> Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

NuScale stated, in SDAA Part 7, “Exemptions”, Section 4, that it requests an exemption from GDC 17 because the design contains no safety-related functions that rely on electric power. NuScale stated that the design of the NuScale Power Plant provides passive safety systems and features to accomplish plant safety-related functions without reliance on electric power, and that the design, therefore, meets the underlying intent of GDC 17 without the need for the electric power systems specified in GDC 17. NuScale further stated that it requests an exemption from the GDC 18 requirements for inspection and testing of electric power systems and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 to address conforming changes and that the underlying intent of these requirements, to ensure sufficient electric power is available to accomplish the safety functions of the respective systems, is met without reliance on electric power.

For offsite power, FSAR Section 8.2 states that the passive design of the plant does not rely on AC power and does not require an offsite power system to perform safety-related or risk-significant functions. SER Section 8.2 contains the staff’s evaluation of offsite power. SER Section 15.0.0.6.2 states that offsite power is not credited to mitigate Chapter 15 events.

Therefore, the staff finds that offsite power is not needed for accident mitigation or safe shutdown and thereby is nonsafety related.

For the onsite AC systems, FSAR Section 8.3 states that the onsite power systems include AC power systems, and the plant safety-related functions are achieved and maintained without reliance on onsite AC electric power. Further, the applicant stated that the onsite power systems do not perform any risk-significant functions. SER Section 8.3.1 contains the staff's evaluation of the onsite AC systems. SER Section 15.0.0.6.2 states that the normal AC power systems are not safety related and are not credited to mitigate Chapter 15 events. Therefore, the staff finds that the onsite AC systems are not needed for accident mitigation or safe shutdown and thereby are nonsafety related.

For the onsite DC systems, in SER Section 8.3.2, the staff used a risk-informed, graded approach to evaluate the quality aspects of the augmented DC power system (EDAS). In SER Section 8.3.2, the staff finds that the EDAS is nonsafety related with augmented quality and is acceptable. Chapter 19 discusses the availability controls related to the EDAS. The staff finds that the augmented quality and availability controls for the DC systems are acceptable. EDAS, with the augmented quality and availability controls, supports a finding that the SDA provides reasonable assurance of adequate protection of public health and safety. The staff considers EDAS to be a non-safety-related or non-Class 1E SSC that performs an important to safety function, based on its role to protect specified acceptable fuel design limits, as discussed in SER Section 15.0.0.6.2, and there is reasonable assurance the system will function as designed. Therefore, using risk-informed decision-making and a graded approach, the staff finds the onsite DC systems, including the EDAS, are not safety related and, EDAS includes augmented provisions.

Therefore, the staff finds that the NuScale US460 design meets the underlying intent of GDC 17. NuScale further requested an exemption from the GDC 18 requirements for inspection and testing of electric power systems and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44, to address conforming changes. It also noted that the underlying intent of these requirements, to ensure sufficient electric power is available to accomplish the safety functions of the respective systems, is met without reliance on electric power.

Based on the non-Class 1E classification of the onsite and offsite electric power systems, and on the analysis described in Section 8.1.3 to support the staff's findings regarding the criteria in 10 CFR 50.12, "Specific exemptions," the staff finds that the application of these regulations to the NuScale SMR design would not serve the underlying purpose of the rule from which an exemption is being sought or would not be necessary to achieve the underlying purpose of the rule. Accordingly, the staff finds that the requested exemption from GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.1.3 Evaluation of the Exemption Criteria of 10 CFR 50.12

Under 10 CFR 52.7, "Specific exemptions," the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of

10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.” As 10 CFR 52.7 further explains, the Commission’s consideration will be governed by 10 CFR 50.12, which states that an exemption may be granted when (1) the exemptions are authorized by law, will not present an undue risk to public health and safety, and are consistent with the common defense and security, and (2) special circumstances are present. Specifically, 10 CFR 50.12(a)(2) lists six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present for the NRC to consider granting an exemption request.

8.1.3.1 Authorized by Law

The NRC staff has determined that granting the applicant’s proposed exemptions will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission’s regulations because, as stated above, 10 CFR Part 52 allows the NRC to grant exemptions where the exemption criteria are satisfied. Therefore, in accordance with 10 CFR 50.12(a)(1), the staff finds that the exemptions would be authorized by law.

8.1.3.2 No Undue Risk to Public Health and Safety

The proposed exemptions will not impact the consequences of any DBE or create new accident precursors. The design does not rely on electric power systems to provide sufficient capacity and capability to ensure that (1) specified acceptable fuel design limits and design conditions of the RCPB are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. Therefore, in accordance with 10 10 CFR 50.12(a)(1), the staff finds that the exemptions would pose no undue risk to public health and safety.

8.1.3.3 Consistent with the Common Defense and Security

The proposed exemptions do not affect the design, function, or operation of any structures or plant equipment necessary to maintain a safe and secure plant status. In addition, the proposed exemptions do not impact the SDA’s plant security power system and have no impact on plant security or safeguards procedures. Therefore, in accordance with 10 CFR 50.12(a)(1), the staff finds that the exemptions would not impact the common defense and security.

8.1.3.4 Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. SER Section 8.1.2 discusses GDC 17, GDC 18, and the electric power provisions in GDC 33, 34, 35, 38, 41, and 44. The underlying purpose of the requirement in GDC 17 to provide onsite and offsite electric power systems to the plant is to ensure sufficient power to accomplish safety functions.

The underlying purpose of the requirement in GDC 18 to design electric power systems to permit inspection and testing is to ensure the capability for periodic inspection and testing of the power systems that are subject to GDC 17. The underlying purpose of the electric power provisions in GDC 33, 34, 35, 38, 41, and 44 is to ensure that the safety functions described in each of these GDC can still be accomplished when the onsite and offsite electric power systems are not available.

The NuScale US460 design does not rely on power to accomplish safety-related or important-to-safety functions, and therefore the underlying intent of GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 is met without the need for onsite and offsite electric power systems.

The staff finds that the NuScale US460 design meets the underlying purpose of these regulations because the onsite and offsite electric power systems are not classified as Class 1E.

8.1.4 Conclusion

For the reasons given above, as set forth in 10 CFR 50.12(a), the staff concludes that the proposed exemptions requested in SDAA Part 7, Section 4 and Section 5, regarding requirements stated in GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 are authorized by law; will not present an undue risk to public health and safety; and are consistent with the common defense and security. Also, the special circumstances described in 10 CFR 50.12(a)(2)(ii) are present, in that the application of GDC 17, GDC 18, and the electric power provisions in GDC 33, 34, 35, 38, 41, and 44 in the particular circumstances is not necessary to achieve the underlying purpose of these rules. Therefore, the staff concludes that an exemption from the requirements of GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 , if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemptions. Where there are changes to the design material to the bases for the exemptions, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.

8.2 Offsite Power System

8.2.1 Introduction

The offsite power system for the NuScale Power Plant includes connections to a transmission grid, micro-grid, or dedicated service load, as stated in FSAR Section 8.2. Section 8.2 further indicates that the boundary between the onsite AC power system and the offsite power system is at the point of common coupling where the plant switchyard and utility grid conductors are connected. The offsite power system is not required to achieve and maintain safe shutdown. FSAR Section 8.2 states that the passive design of the NuScale Power Plant does not require an offsite power system to perform safety-related or risk-significant functions, and the design supports exemption from GDC 17 and 18. The objective of the staff's review is to determine whether the offsite power system satisfies the requirements in 10 CFR 52.137(a)(15) and GDC 5, "Sharing of structures, systems, and components," and whether it will perform its design function during all plant operating and accident conditions. In addition, the staff reviewed the technical basis for the applicant's requested exemption from GDC 17, 18, 33, 34, 35, 38, 41, and 44.

8.2.2 Summary of Application

FSAR: The applicant provided a system description in FSAR Section 8.2, summarized, in part, as follows:

> The offsite power system includes connections to a transmission grid, micro-grid, or dedicated service load. The boundary between the onsite alternating current (AC) power system and the offsite power system is at the point of common

coupling where the plant switchyard and utility grid conductors are connected. The switchyard is part of the high voltage AC electrical distribution system.

The passive design of the plant does not rely on AC power and does not require an offsite power system to perform safety-related or risk-significant functions. Accordingly, the design supports an exemption from GDC 17 and GDC 18. Therefore, this section provides the relevant regulatory framework, but the acceptance criteria within the Design Specific Review Standard (DSRS) are not applicable to the design as there are no Class 1E power distribution systems.

During normal operations with at least one NuScale Power Module operating, the associated turbine generator is the source of power to the onsite AC power system as described in Section 8.3.1. A single turbine generator has sufficient capacity to meet the maximum expected total auxiliary AC load requirements for up to six NuScale Power Modules such that excess power is supplied to the offsite power system if one or more turbine generators are operating.

If provided, offsite power is the primary source for plant startup. The plant has the capability to start up and operate independently from the offsite power system in island mode as discussed in Section 8.3.1.

ITAAC: There are no inspections, tests, analyses, and acceptance criteria (ITAAC) associated with the offsite power system.

Technical Specifications: There are no technical specifications applicable to the offsite power system.

8.2.3 Regulatory Basis

DSRS Section 8.2 provides the relevant NRC requirements for the offsite power system and the associated acceptance criteria, as summarized below:

- GDC 2, “Design bases for protection against natural phenomena,” as it relates to the SSCs of the offsite power system being capable of withstanding the effects of natural phenomena
- GDC 4, “Environmental and dynamic effects design bases,” as it relates to protection of the SSCs of the offsite power system from dynamic effects, including the effects of missiles that may result from equipment failures during normal operation, maintenance, testing, and postulated accidents
- GDC 5, as it relates to the sharing of SSCs of the preferred power systems, including the switchyard and all circuits from the switchyard to the onsite power distribution systems of each module
- GDC 17, as it relates to the preferred power system’s (1) capacity and capability to permit functioning of SSCs important to safety, (2) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies, (3) physical independence, (4) availability, and (5) capability
- GDC 18, as it relates to the inspection and testing of the offsite electric power system

- GDC 33, 34, 35, 38, 41, and 44, as they relate to the operation of the offsite electric power system in GDC 17 to ensure that the safety functions of the systems described in GDC 33, 34, 35, 38, 41, and 44 are accomplished under the assumption of a single failure, where applicable

- 10 CFR 52.137(a)(15), as it relates to the ability for a passive design to cope with an SBO for 72 hours with no operator actions

The applicant requested an exemption from GDC 17, GDC 18, and the electric power provisions in GDC 33, 24, 35, 38, 41, and 44, as discussed above. It should be noted that the applicant has requested exemption for all provisions of GDC 33, however, only the electrical provisions are addressed in this chapter of the SE. Further provisions are discussed in the Chapter 9 SE.

The following guidance is available:

- RG 1.32, which endorses IEEE Std. 308-2001, relates to the availability and number of immediate access circuits from the transmission network.

- RG 1.68, "Initial test Programs for Water-Cooled Nuclear Power Plants," relates to the initial test program.

- RG 1.155, "Station Blackout," relates to the adequacy of the alternate AC (AAC) power source and the independence of the AAC power source from the offsite and onsite power systems and sources. New applications must provide an adequate AAC source of diverse design (with respect to AC onsite emergency sources) that is consistent with the guidance in RG 1.155 and is capable of powering at least one complete set of normal safe-shutdown loads.

- RG 1.204, "Guidelines for Lightning Protection of Nuclear Power Plants"; IEEE Std. 665-1995 (reaffirmed 2001), "IEEE Guide for Generating Station Grounding"; IEEE Std. 666-1991 (reaffirmed 1996), "IEEE Design Guide for Electric Power Service Systems for Generating Stations"; IEEE Std. 1050-1996, "IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations"; and IEEE Std. C62.23-1995 (reaffirmed 2001), "IEEE Application Guide for Surge Protection of Electric Generating Plants," relate to the design, installation, and performance of station grounding systems and surge and lightning protection systems.

- RG 1.206, "Applications for Nuclear Power Plants," relates to power system analytical studies and stability studies to verify the capability of the offsite power systems and their interfaces with the onsite power system.

- SECY-91-078, "Chapter 11 of the Electric Power Research Institute's (EPRI's Requirements Document and Additional Evolutionary Light Water Reactor (LWR) Certification issues," dated March 25, 1991 (ML12255A549), relates to the interface between the onsite AC power system and the offsite power system.

- SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs," dated March 28, 1994 (ML003708068), relates to the policy and technical issues associated with the regulatory treatment of nonsafety systems (RTNSS) affecting passive plant designs.

- SECY-95-132, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084),” dated May 22, 1995 (ML003708005), relates to the policy and technical issues associated with the RTNSS affecting passive plant designs.

- SRP Branch Technical Position (BTP) 8-3, “Stability of Offsite Power Systems,” relates to stability studies for the electrical transmission grid that would be used to provide offsite power sources to the plant.

- SRP BTP 8-6, “Adequacy of Station Electric Distribution System Voltages,” relates to adverse effects on the Class 1E loads that can be caused by sustained degraded grid voltage conditions when the Class 1E buses are connected to offsite power.

- SRP BTP 8-9, “Open Phase Conditions in Electric Power System,” relates to the vulnerability of the electric power system design resulting from open phase conditions in offsite electric power systems.

8.2.4 Technical Evaluation

8.2.4.1 Compliance with GDC 2 and GDC 4

GDC 2 states that SSCs important to safety shall be designed to withstand the effects of natural phenomena without loss of capability to perform their safety functions. Thus, GDC 2 requires that the offsite power system retain the capability to perform its functions during the most severe natural phenomena that have been reported historically for the site and surrounding area.

GDC 4 states that SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. These SSCs shall be appropriately protected against dynamic effects that may result from equipment failures and from events and conditions outside the nuclear power unit.

As discussed in DSRS Table 8.1-1, “Acceptance Criteria and Guidelines for Electric Power Systems,” GDC 2 and GDC 4 do not apply to the offsite power system. Specifically, the offsite power system is not safety related and does not perform or support an important-to-safety function in that it is not needed for core cooling, containment integrity, and maintaining fuel limits, or to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. Therefore, the staff finds that GDC 2 and GDC 4 do not apply to the NuScale offsite power system design.

8.2.4.2 Compliance with GDC 5

The GDC 5 requirement relates to the sharing of SSCs of the preferred (offsite) power systems, including the switchyard and all circuits from the switchyard to the onsite power distribution systems of each module.

DSRS Section 8.2.II states, in part, that the shared switchyard in multimodule plant configurations must meet GDC 5, thereby ensuring that an accident in one module of a multimodule facility can be mitigated using an available complement of mitigative features, irrespective of conditions in the other units and without giving rise to conditions unduly adverse to safety in another unit. DSRS Section 8.2.II also states that meeting the requirements of GDC 5 provides assurance that an accident within any one unit of a multimodule plant may be

mitigated, irrespective of conditions in other units, without affecting the overall operability of the offsite power system.

FSAR Table 8.1-1 indicates that GDC 5 is not applicable for the offsite power systems. FSAR Section 8.2.1 states that the passive design of the plant does not rely on AC power and does not require an offsite power system to perform safety-related or risk-significant functions. The NuScale US460 design does not rely on electric grid connections and grid stability for safe operation, and the NuScale US460 design does not rely on AC or DC power systems for safe shutdown and accident mitigation. Therefore, the staff finds that GDC 5 is not applicable.

8.2.4.3 Compliance with GDC 17

GDC 17 states that offsite power shall be provided to allow SSCs important to safety to function and that two physically independent circuits shall supply electric power from the transmission network to the onsite distribution system.

FSAR Section 8.2.1, "Description," states the following:

> The passive design of the plant does not rely on AC power and does not require an offsite power system to perform safety-related or risk-significant functions. Accordingly, the design supports an exemption from GDC 17 and GDC 18.

SDAA Part 7 discusses NuScale's request for exemption from GDC 17. SDAA Part 7, Section 4.2.1, "Technical Basis," states that safety-related functions are achieved and maintained with no reliance on electric power. Further, the offsite power system is not needed for core cooling, containment integrity, and maintaining fuel limits, or to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. As discussed in SER Section 8.1.4, the staff has determined that the exemption from GDC 17, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemptions. Where there are changes to the design material to the bases for the exemptions, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.

8.2.4.4 Compliance with GDC 18

GDC 18 discusses the inspection and testing of electric power systems important to safety. FSAR Table 8.1-1 states that the NuScale US460 design supports an exemption from GDC 18.

SDAA Part 7, Section 4.1.1, states that no safety-related functions in the NuScale US460 standard design rely on electric power and use passive safety systems and features to accomplish safety-related functions without reliance on electric power. SDAA Part 7, Section 4.2.2, states, in part, that AC and DC power systems are non-safety-related and non-Class 1E systems. The electric power systems are not relied on to perform safety functions or meet the acceptance criteria of GDC 17. Therefore, conformance with the inspection and testing provisions of GDC 18 is unnecessary to verify electric power system capabilities.

Furthermore, FSAR Section 8.3 states that the design does not rely on AC or DC power systems, and the staff finds that the offsite electric power systems do not warrant a Class 1E designation and are non-Class 1E systems. As discussed in SER Section 8.1.4, the staff has determined that the exemption from GDC 18, regarding testability requirements with respect to

the capability of inspection and testing of the offsite power system and equipment, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemptions. Where there are changes to the design material to the bases for the exemptions, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.

8.2.4.5 Compliance with GDC 33, 34, 35, 38, 41, and 44

GDC 33, 34, 35, 38, 41, and 44 state requirements for safety systems for which access to both offsite and onsite electric power sources must be provided. Compliance with these criteria requires that capability be provided for reactor coolant makeup (GDC 33), residual heat removal (GDC 34), emergency core cooling (GDC 35), containment heat removal (GDC 38), containment atmosphere cleanup (GDC 41), and cooling water for SSCs important to safety (GDC 44). The applicant has requested an exemption from these criteria in SDAA Part 7.

DSRS Section 8.2 states the following:

> Passive reactor designs incorporate passive safety-related systems for core cooling and containment integrity and, therefore, do not depend on the electric power grid connection and grid stability for safe operation. They are designed to automatically establish and maintain safe-shutdown conditions after DBEs for the first 72 hours, without operator action, following a loss of both onsite and offsite AC power sources. Consequently, such passive reactor designs are not required to meet the requirements of GDC 33, 34, 35, 38, 41, and 44 for 72 hours.

FSAR Section 8.2.2.1 states that the NuScale plant design complies with a set of principal design criteria in lieu of GDC 33, 34, 35, 38, 41, and 44 and that these principal design criteria do not include requirements for electric power systems. FSAR Section 8.4.1, "SBO Analysis and Results," states that a safe and stable shutdown is automatically achieved and maintained for 72 hours without operator actions.

Furthermore, FSAR Section 8.3 states that the design does not rely on AC or DC power systems, and the staff finds that the offsite electric power systems do not warrant a Class 1E designation and are not safety related. As discussed in SER Section 8.1.4, the staff has determined that an exemption from the electric power provisions of GDC 33, 34, 35, 38, 41, and 44, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemptions. Where there are changes to the design material to the bases for the exemptions, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.

8.2.4.6 Compliance with 10 CFR 52.137(a)(15) and Conformance to Regulatory Guide 1.155

Consistent with the guidance in DSRS Section 8.2.II, compliance with the requirements of 10 CFR 52.137(a)(15) requires that each light-water-cooled nuclear power plant (NPP) be able to withstand or cope with (and recover from) an SBO. Furthermore, DSRS Section 8.2.II states that, if a passive design can cope with an SBO for 72 hours with no operator actions and with the use of only Class 1E DC power, 10 CFR 52.137(a)(15) is satisfied. RG 1.155 discusses the independence of an AC power source from the offsite and onsite power systems and sources.

The staff reviewed the offsite power system to ensure that the failure of the offsite system will not affect the NuScale Power Plant's ability to cope with an SBO. FSAR Section 8.4.1 states that a safe and stable shutdown is automatically achieved and maintained for 72 hours without operator actions. Additionally, the NuScale US460 design has onsite DC power systems that are non-Class 1E and not safety related. SER Section 8.4 contains the staff evaluation on the capability of withstanding or coping with, and recovering from, an SBO of a specified duration. As described in FSAR Section 8.4, the NuScale Power Module design does not rely on onsite or offsite AC power for the performance of safety-related functions during a DBE, and as a result, the design does not include emergency onsite AC power. The staff finds that the offsite power system is not needed to demonstrate compliance with 10 CFR 52.137(a)(15) and conformance to the guidance in RG 1.155.

8.2.4.7 Compliance with Generic Letter 2007-01 and RG 1.218

In Generic Letter (GL) 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," dated February 7, 2007 (ML070360665), and the associated summary report, dated November 12, 2008 (ML082760385), the NRC staff discussed cable failures and found that (1) the predominant factor contributing to cable failures at NPPs appears to be the presence of water or moisture or exposure of cables to submerged conditions, and (2) licensees should have a program for using available diagnostic cable testing methods to assess the cable condition. FSAR Table 1.9-2 states that GL 2007-01 partially conforms and states that—

> 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 applicant applying the guidance of RG 1.218.

RG 1.218, "Condition Monitoring techniques for Electric Cables Used in Nuclear Power Plants," provides information on monitoring the performance of electric cables used in NPPs. FSAR Table 1.9-2 and FSAR Section 8.2.2, "Analysis," state that RG 1.218 is not applicable.

The staff agrees with the applicant that RG 1.128 addresses monitoring the performance of electric cables used in NPPs. The staff determined that, due to the exemptions from GDC 17 and GDC 18, the applicant is not required to provide an inspection, monitoring, or testing program for cables that connect offsite power to safety buses, cables that connect an emergency diesel generator (EDG) to a safety bus, or cables that provide power to an active emergency core cooling system (ECCS). The staff agrees that RG 1.218 is not applicable, partial conformance to GL 2007-01 is acceptable for power cables within the scope of 10 CFR 50.65.

8.2.4.8 Conformance to Regulatory Guide 1.32

RG 1.32 relates to the criteria for power systems and endorses IEEE Std. 308-2001. IEEE Std. 308-2001 discusses the offsite power system in Section 5.2.3, "Preferred Power Supply," and states that the preferred power supply consists of two or more circuits from the transmission system.

FSAR Table 8.1-1 states that RG 1.32 does not apply to the offsite power system. The staff agrees with the applicant that RG 1.32 addresses design criteria for safety-related power systems. The NuScale US460 design does not depend on offsite power for safe operation and

does not rely on offsite power to support any safety-related function. Therefore, the staff finds that RG 1.32 is not applicable to the NuScale US460 design in regard to the offsite power system.

8.2.4.9 Conformance to Regulatory Guide 1.68

DSRS Table 8.1-1 states that RG 1.68 may be used as guidance for offsite power systems and that RG 1.68 is used as guidance for FSAR Section 8.2.

The staff agrees with the applicant that RG 1.32 addresses design criteria for safety-related power systems. The NuScale US460 design does not depend on offsite power for safe operation and does not rely on offsite power to support any safety-related function. Therefore, the staff finds that RG 1.68 is not applicable to the NuScale US460 design with regard to the offsite power system.

8.2.4.10 Conformance to Regulatory Guide 1.204

DSRS Section 8.2 states that adequate provisions are made in the design of the plant and the offsite and onsite power systems for grounding, surge protection, and lightning protection. The staff evaluated the plant/station grounding systems, the methods of equipment and structural grounding, AC power system neutral grounding and ground fault current limiting features, surge and lightning protection features for outdoor equipment and circuits, and the measures for isolation of instrumentation grounding systems. RG 1.204, IEEE Std. 665-1995 (reaffirmed 2001), IEEE Std. 666-1991 (reaffirmed 1996), IEEE Std. 1050-1996, and IEEE Std. C62.23-1995 (reaffirmed 2001) provide acceptable guidelines for the design, installation, and performance of station grounding systems and surge and lightning protection systems, as discussed in DSRS Section 8.2. FSAR Table 8.1-1 and Table 1.9-2, “Conformance with Regulatory Guides,” state that RG 1.204 does not apply to offsite power systems with respect to FSAR Section 8.2.

The NuScale US460 design does not rely on an electric power grid connection and grid stability for safe operation, and the design of the switchyard and connections would not be required to show compliance with RG 1.204 or industry standards to demonstrate compliance with GDC 17.

Furthermore, FSAR Section 8.3 states that the design does not rely on AC or DC power systems. The staff finds that the offsite electric power systems do not warrant a Class 1E designation, and they are non-Class 1E systems. As discussed in SER Section 8.1.4, the staff has determined that an exemption from GDC 17, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale’s SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.2.4.11 Conformance to Regulatory Guide 1.206 and SRP Branch Technical Position 8-3

FSAR Table 8.1-1 states that RG 1.206 is not applicable to FSAR Section 8.2, and SRP BTP 8-3 is used as guidance for FSAR Section 8.2. The NuScale US460 design does not rely on electric grid connections and grid stability for safe operation and does not rely on AC or DC power systems. Therefore, the staff finds that RG 1.206 and SRP BPT 8-3 are not applicable.

8.2.4.12 Conformance to SRP Branch Technical Position 8-6

SRP BTP 8-6 discusses adverse effects on the Class 1E loads that can be caused by sustained degraded grid voltage conditions when the Class 1E buses are connected to offsite power. FSAR Table 8.1-1 states that SRP BTP 8-6 is not applicable. Further, FSAR Section 8.2.2 states that SRP BTP 8-6 does not apply to the offsite power system. In addition, FSAR Section 8.2.2.1 states that the offsite power system does not supply power to Class 1E loads and does not support safety-related functions. The staff finds that SRP BTP 8-6 does not apply to offsite power systems, since the offsite power system does not warrant a Class 1E designation, and offsite power systems are not safety-related systems, as discussed in SER Section 8.1.4.

8.2.4.13 Conformance to SRP Branch Technical Position 8-9

On July 27, 2012, the staff issued NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," (ML12074A115) to all holders of operating licenses and combined licenses (COLs) requesting information about facilities' electric power system designs. The intended purpose of the bulletin was to affirm that all plants comply with the GDC 17 requirements and to evaluate whether any further regulatory action is warranted to address this design vulnerability. SRP BTP 8-9 discusses the vulnerability of the electric power system design resulting from open phase conditions in offsite electric power systems.

FSAR Table 8.1-1 states that SRP BTP 8-9 is not applicable for FSAR Section 8.2, and Bulletin 2012-01 is used as guidance for Section 8.2 on open phase conditions in the grid. FSAR Section 8.2 states that the offsite power system does not support safety-related functions, and failures of the offsite power system, including open phase conditions or an SBO, do not prevent the operation of safety-related functions. Furthermore, FSAR Section 8.2.2.1 states the following:

> If the offsite power system is supplying power to the onsite AC power system, the electrical isolation between the augmented 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.

DSRS Section 8.2, Section III, Item 3.H, states that (1) no single event, including a single protective relay, interlock, or switchgear failure, in the case 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 for the offsite system evaluates the effects of failures, including loss of a relay or switchgear, and an open phase event.

NuScale requested an exemption from GDC 17, and an AC equipment failure caused by an open phase condition does not prevent the operation of safety-related equipment. FSAR Section 8.3 states that the design does not rely on AC or DC power systems, and the staff finds that the offsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As discussed in SER Section 8.1.4, the staff has determined that an exemption from GDC 17, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are

changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.2.4.14 Conformance to SECY-91-078, SECY-94-084, and SECY-95-132

DSRS Table 8.1-1 states that SECY-94-084 and SECY-95-132 provide guidance that relates to the inclusion of an alternate power source to nonsafety loads for evolutionary plant designs. DSRS Section 8.2.III.3.A states that, for SECY-94-084 and SECY-95-132, the design review should identify any offsite power requirements to support non-Class 1E, risk-significant, active systems identified through the RTNSS process. SER Section 19.3 further discusses and evaluates the RTNSS.

FSAR Table 8.1-1 states that SECY-94-084 and SECY-95-132 provide guidance for the offsite power system. FSAR Section 8.2.2 explains that, for conformance to SECY-94-084 and SECY-95-132, the offsite power system has no safety-related or risk-significant loads and an AAC source or safety-related EDG is not needed, consistent with the guidance in SECY-94-084 and SECY-95-132. The staff finds that SECY-94-084 and SECY-95-132 are not applicable since the offsite power system has no safety-related or risk-significant loads and is a non-safety-related system.

The applicant stated, in FSAR Table 8.1-1, that SECY-91-078 does not apply to the offsite power system. The staff finds that since the NuScale US460 design is a passive plant design and offsite power can be classified as a non-Class 1E system, as discussed in SER Section 8.1.4, SECY-91-078 is not applicable to the NuScale US460 design.

8.2.5 Combined License Information Items

No COL items are provided for this section.

8.2.6 Conclusion

As set forth above, the staff has reviewed all the relevant information that is applicable to GDC 5, 10 CFR 52.137(a)(15), and conformance to RGs, standards, and BTPs committed to by the applicant. The staff also assessed the technical basis for the applicant's requested exemption from GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44. The staff also reviewed the COL information items in FSAR Table 1.8-1. The staff concludes that the applicant has provided sufficient information in the FSAR and identified necessary analyses to support the bases for its conclusions about the offsite power system design. The staff concludes that the design of the NuScale offsite power system meets the appropriate regulatory requirements listed in FSAR Section 8.2.2 and discussed in the staff's technical evaluations in SER Section 8.2.4. Additionally, the staff determined that the applicant's request for an exemption from the requirements of GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 with respect to the offsite power system, as discussed in SER Section 8.1.4, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemptions. Where there are changes to the design material to the bases for the exemptions, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.

8.3 Onsite Power Systems

8.3.1 Alternating Current Power Systems

8.3.1.1 Introduction

The NuScale onsite power system is designed to provide electric power to the plant loads during all modes of plant operation.

The onsite power system includes AC and DC power systems. This section discusses the AC power system for plant loads, and SER Section 8.3.2 discusses the DC system. NuScale states in Section 8.3 that the plant safety-related functions are achieved and maintained without reliance on electric power; therefore, neither the AC nor DC power systems are needed to be safety related (i.e., Class 1E). The objective of the staff review is to determine that the onsite AC power system will perform its design function during all plant operating conditions and that the NuScale US 460 standard design establishes nonreliance on electric power for accident conditions.

8.3.1.2 Summary of Application

FSAR: The applicant provided a system description in FSAR, Section 8.3.1, summarized, in part, as follows:

> The onsite AC power systems distribute AC power to the onsite DC power systems (through battery chargers) and to the plant AC electrical loads during startup and shutdown, normal operation, and off-normal conditions. The design does not use nor include an emergency onsite AC power system. The onsite AC power systems are shared among the NuScale Power Modules and include the following:
>
> • normal power distribution system
>
> - high voltage AC electrical distribution system (EHVS) with nominal bus voltage of 13.8 kV and 345 kV switchyard
> - medium voltage AC electrical distribution system (EMVS) with nominal bus voltage of 4.16 kV
> - low voltage AC electrical distribution system (ELVS) with nominal bus voltage of 480 V
>
> • backup power supply system (BPSS).

ITAAC: There are no ITAAC associated with the onsite AC power system.

Technical Specifications: There are no technical specifications applicable to the onsite AC power system.

8.3.1.3 Regulatory Basis

DSRS Section 8.3.1 contains the relevant NRC requirements for the onsite AC power system and the associated acceptance criteria, as summarized below. (DSRS Section 8.3.1 also provides review interfaces with other DSRS sections.)

- GDC 2, as it relates to the SSCs of the AC power system being capable of withstanding the effects of natural phenomena without the loss of the capability to perform their safety functions.

- GDC 4, as it relates to the SSCs of the AC power system being capable of withstanding the effects of missiles and environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

- GDC 5, as it relates to the sharing of SSCs of the AC power systems.

- GDC 17, as it relates to the onsite AC power system's (1) capacity and capability to permit functioning of SSCs important to safety, (2) independence, redundancy, and testability to perform its safety function assuming a single failure, and (3) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or the loss of power from the transmission network. (The applicant requested an exemption from this criterion.)

- GDC 18, as it relates to inspection and testing of the onsite power systems. (The applicant requested an exemption from this criterion.)

- GDC 33, as it relates to reactor coolant makeup (The applicant requested an exemption from this criterion).

- GDC 34, 35, 38, 41, and 44, as they relate to GDC 17 to ensure the accomplishment of the safety functions as described therein. (The applicant requested an exemption from the electric power provisions in these criteria.)

- GDC 50, as it relates to the design of containment electrical penetrations that contain circuits of the AC power system and the capability of electric penetration assemblies in containment structures to accommodate a LOCA without loss of mechanical integrity and the external circuit protection for such penetrations.

- 10 CFR 50.34(f)(2)(xiii), as it relates to Additional TMI Item II.E.3.1. (The applicant requested an exemption from this criterion.)

- 10 CFR 50.34(f)(2)(xx), as it relates to Additional TMI Item II.G.1. (The applicant requested an exemption from this criterion.)

- 10 CFR 50.55a(h), as it relates to the incorporation of IEEE Std. 603-1991, including the correction sheet, dated January 30, 1995.

The guidance and acceptance criteria for meeting the above regulatory requirements in accordance with the DSRS are as follows:

- RG 1.6, Regulatory Positions D.1, D.3, and D.4, as they relate to the independence between redundant onsite AC power sources and between their distribution systems

- RG 1.32, as it relates to the design, operation, and testing of the safety-related portions of the onsite AC power system

- RG 1.53, as it relates to the application of the single-failure criterion

- RG 1.63, as it relates to the capability of electric penetration assemblies in containment structures to withstand a LOCA without loss of mechanical integrity and the external circuit protection for such penetrations (GDC 50)

- RG 1.68, as it relates to initial test programs for the onsite AC power systems for water-cooled NPPs
- RG 1.75, as it relates to the physical independence of the circuits and electrical equipment that comprise or are associated with the onsite AC power system
- RG 1.81, as it relates to the sharing of the SSCs (power sources) of the AC power system
- RG 1.106, “Thermal Overload Protection for Electrical Motors on Motor-Operated Valves,” as it relates to safety-related motor-operated valves (MOVs) of the onsite AC power system
- RG 1.118, as it relates to the capability to periodically test the onsite AC power system (GDC 18)
- RG 1.153, as it relates to the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety systems of nuclear plants, including the application of the single-failure criterion in the onsite DC power system
- RG 1.155, as it relates to the capability and the capacity of the onsite AC power system for an SBO, including the operation of the AAC power source(s)
- RG 1.204, as it relates to the design, installation, and performance of station grounding systems and surge and lightning protection systems
- RG 1.218, as it relates to monitoring the condition of cables within the onsite AC power system that have been determined to fall within the scope of the Maintenance Rule
- SRP BTP 8-2, which states that EDGs should not be used for peaking service
- SRP BTP 8-6, as it relates to the analysis, testing, and selection of the undervoltage and degraded voltage setpoints and associated time delays
- SRP BTP 8-9, as it relates to providing protection to safety-related AC loads in the event of an open-phase condition on the high side of a unit auxiliary transformer (UAT)
- SECY-91-078, as it relates to the interface between the onsite AC power system and the offsite power system
- SECY-94-084, as it relates to the policy and technical issues associated with the RTNSS affecting passive plant designs
- SECY-95-132, as it relates to the policy and technical issues associated with the RTNSS affecting passive plant designs

8.3.1.4 Technical Evaluation

FSAR Section 8.3 states that “the plant safety-related functions are achieved and maintained without reliance on electric power; therefore, neither the AC power systems nor the DC power systems are safety-related (Class 1E). The onsite power systems do not perform any risk-significant functions.”

FSAR Section 8.3.1.1, “System Description,” states that “the normal source of onsite AC electric power is from the operating NPM turbine generators through the EHVS, the EMVS, and the ELVS. The EHVS contains the switchyard, which is connected to the offsite transmission grid, a micro-grid, or both.”

In FSAR Section 8.3.1.1.1, “Backup Power Supply System,” the applicant states that the backup diesel generators (BDGs) provide backup power to EDAS and selected loads via connection to the EMVS. SER Section 8.3.1.4.4 describes and evaluates BDGs, which are nonsafety systems.

FSAR Section 8.3.1.1 discusses island-mode operation. In island mode, the plant turbine generators provide power to onsite AC loads. The staff did not review island mode since it is not credited to meet any regulatory or safety-related criteria.

8.3.1.4.1 Compliance with GDC 2

GDC 2 requires, in part, that SSCs important to safety be capable of withstanding the effects of natural phenomena without the loss of the capability to perform their safety functions.

The NuScale US460 design is a passive design, and the applicant stated in FSAR Section 8.3.1.2.2 that the onsite AC power system does not contain any SSCs that are required to function in the event of natural phenomena. Accordingly, the applicant stated, in part, that nonsafety-related SSCs are designed to Seismic Category II requirements so that their failure does not affect the ability of safety-related SSCs to perform their intended functions. SER Chapter 3 evaluates seismic qualification.

In its review, the staff evaluated the onsite AC power system and determined that the onsite AC power system is not safety related. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. Therefore, since the onsite AC power system is not safety related, and with the exception of potential adverse seismic interactions (discussed in Chapter 3 of this report), its failure does not affect the ability of safety-related SSCs to perform their function. The staff finds that the application of seismic Category II requirements (as referenced above) to the onsite AC power system is an acceptable means to address adverse seismic interactions. Therefore, the staff finds that the onsite AC power system meets the requirements of GDC 2.

8.3.1.4.2 Compliance with GDC 4

GDC 4 requires that SSCs important to safety be capable of withstanding the effects of missiles and environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs.

The NuScale US460 design is a passive design, and the onsite AC power systems do not perform any risk-significant functions. In FSAR Section 8.3.1.2.2, the applicant stated the onsite AC power system does not contain SSCs required to function under adverse environmental conditions associated with postulated accidents, including a loss-of-coolant accident. The applicant further stated that non-Class 1E AC power system SSCs are designed to operate within the environmental conditions associated with normal operation, maintenance, and testing. Failure of the onsite AC power system components does not introduce adverse environmental conditions that would affect the ability of any safety-related SSC to perform its intended function.

Per Section 8.1.2 of this SER and based upon its review of the onsite electric power systems, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. Since the onsite AC power system is not safety related, the staff finds it is not required to meet the requirements of GDC 4.

8.3.1.4.3 Compliance with GDC 5

GDC 5 requires, in part, that SSCs important to safety not be shared among other nuclear units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions.

FSAR, Section 8.3.1.2.2, "Onsite Alternating Current Power System Conformance with Regulatory Framework," states that onsite AC power systems are shared among the NPMs and that failures affecting the onsite AC power systems do not affect the ability to achieve and maintain NPM safety functions, including a DBE in one NPM.

The applicant stated that, as described in FSAR Table 8.3-2, the EHVS, EMVS, and ELVS systems are non-Class 1E systems whose functions are not safety related and not risk significant. Because the onsite power systems are not required nor credited to support DBE mitigation, EHVS failures do not affect the ability to achieve and maintain safety-related functions for any NPM, including a DBE in one NPM, consistent with GDC 5.

Per Section 8.1.2 of this SER, and based upon its review, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The onsite AC power system is not safety related and although common to all of the NPMs, its loss does not prevent safe shutdown of all the NPMs even if one is undergoing an accident. Therefore, the staff finds that the onsite power system design complies with the requirements of GDC 5 and is acceptable.

8.3.1.4.4 Compliance with GDC 17

GDC 17 states, in part, that onsite power shall be provided to permit functioning of SSCs important to safety and electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits.

The applicant has requested an exemption from GDC 17, as described in SDAA Part 7.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As discussed above, the staff has determined that the request for an exemption from GDC 17, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.3.1.4.5 Compliance with GDC 18

GDC 18 requires that electric power systems important to safety be designed to permit appropriate periodic inspection and testing of important areas and features to assess their continuity and the condition of their components. These systems shall be designed to test

periodically (1) the operability and functional performance of the components of the systems, such as onsite DC power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practicable, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system.

The applicant has requested an exemption from GDC 18, which is included in SDAA Part 7.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As discussed above, the staff has determined that the request for exemption from GDC 18, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.3.1.4.6 Compliance with GDC 33, 34, 35, 38, 41, and 44

GDC 33, 34, 35, 38, 41, and 44 identify plant safety-related functions, including onsite AC power system requirements for those functions. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The staff also addresses, in Section 8.1.2 of this SER, the applicant's request for exemption from the electric power provisions of GDC 33, 34, 35, 38, 41, and 44. Based upon the findings with regard to the exemption request, the staff has determined that the onsite AC power system is a non-Class 1E system and therefore, the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 are not applicable.

8.3.1.4.7 Compliance with GDC 50

Compliance with GDC 50 requires that the reactor containment structure, including access openings, penetrations, and containment heat removal systems, be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any LOCA. Containment electrical penetration assemblies (EPAs) must therefore be designed to accommodate, without exceeding their design leakage rate, the calculated pressure and temperature conditions resulting from a LOCA. This criterion applies specifically to ensure the integrity of the EPAs in the event of design-basis LOCA conditions. The focus of the Chapter 8 portion of the review of the EPAs is circuit protection. The staff uses RG 1.63 as a guide to evaluate the circuit protection for the circuits that penetrate containment. The structural integrity and environmental qualification aspects of the EPAs are evaluated in Section 6.2.1 and Section 3.11, respectively, of this SER.

In FSAR, Section 8.3.1.2.1, the applicant stated the following with regard to electrical circuits that penetrate the containment:

> The design of electrical penetration assemblies (EPAs) conforms to General Design Criterion (GDC) 50. This section describes the electrical design requirements for EPAs as they relate to compliance with GDC 50. The containment system, including EPAs, can accommodate the calculated pressure and temperature conditions resulting from a

loss-of-coolant accident in accordance with GDC 50 as described in Section 6.2.1. The mechanical design requirements for EPAs are described in Section 3.8.2. The environmental qualification requirements for EPAs are described in Section 3.11.2.

The electrical penetration assemblies are designed in accordance with Institute of Electrical and Electronics Engineers (IEEE) Standard 317-1983 (Reference 8.3-9) as endorsed by Regulatory Guide (RG) 1.63. The EPAs are provided with external circuit protection per Section 5.4 of IEEE Standard 741-1997 (Reference 8.3-10), which is consistent with the 1986 version endorsed by RG 1.63 with the following clarifications.

Self-limiting circuits are those circuits that use EPAs, are not equipped with protection devices, and are supported by analysis that determines that the maximum fault current in these circuits would not damage the penetration if that current is available indefinitely. For these circuits, consideration of special protection devices is not required. For circuits that are not self-limiting, primary and backup protective devices are provided. Electrical penetration assemblies are designed to withstand the maximum available fault and overload currents for the time sufficient for operation of backup devices in case of failure of the primary protection devices.

Circuits contained in some of the EPAs support safety-related functions and are classified as Class 1E. Protection devices for non-Class 1E circuits using EPAs are not required to be treated as Class 1E.

As described in Section 7.1.2, divisional separation for Class 1E circuits is in accordance with Reference 8.3-6, which is endorsed by RG 1.75, “Physical Independence of Electric Systems.”

Based upon its review of the above design criteria, the staff finds that the EPA circuit protection is in conformance with the provisions of RG 1.63. Specifically, Class 1E circuits are provided with Class 1E protection, non-Class 1E circuits are provided with non-Class 1E protection, and the self-limiting circuits are not provided circuit protection. Therefore, the staff finds that the NuScale EPA design meets the requirements of GDC 50 with respect to circuit protection and is acceptable.

8.3.1.4.8 Compliance with 10 CFR 50.34(f)(2)

Certain regulations at 10 CFR 50.34(f)(2) pertain to additional TMI-related requirements for the onsite electrical power system (i.e., 10 CFR 50.34(f)(2)(v) addresses bypass and inoperable status indications to be provided for safety systems (SER Section 7.2.13 addresses this item); 10 CFR 50.34(f)(2)(xiii) addresses the power supply and control for the pressurizer heaters; and 10 CFR 50.34(f)(2)(xx) addresses the pressurizer relief valves, block valves, and level indicators).

In SDAA Part 7, Sections 11 and 12, the applicant requested an exemption from 10 CFR 50.34(f)(2)(xx) and 10 CFR 50.34(f)(2)(xiii), respectively. In SDAA, Part 7, Section 11.1.1, the applicant made the following statement:

NuScale Power, LLC (NuScale), requests an exemption from the portions of 10 CFR 50.34(f)(2)(xx) applicable to pressurizer level indicators.
10 CFR 50.34(f)(2)(xx) specifies power requirements for pressurizer relief valves, block valves, and level indicators. The underlying purpose of the rule is to enable natural circulation core cooling in a loss of offsite power condition. The US460

> standard design does not rely on pressurizer level indication to achieve and maintain natural circulation in a loss of electric power condition, and therefore meets the underlying purpose of the rule.

As for 10 CFR 50.34(f)(2)(xiii), the applicant made the following statement in SDAA Part 7, Section 12.1.1:

> NuScale Power, LLC (NuScale), requests an exemption from 10 CFR 50.34(f)(2)(xiii), which requires providing power supplies for pressurizer heaters and associated motive and control interfaces to establish and maintain natural circulation in hot standby conditions. The underlying purpose of the rule is to enable natural circulation core cooling in a loss of offsite power condition. The NuScale US460 standard design does not rely on pressurizer heaters to achieve and maintain natural circulation in a loss of electric power condition, and therefore meets the underlying purpose of the rule.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems.

The request for exemption from 10 CFR 50.34(f)(2)(xx) and 10 CFR 50.34(f)(2)(xiii) is discussed in Section 5.4.5 of this SER.

8.3.1.4.9 Compliance with 10 CFR 50.55a(h)

Under 10 CFR 50.55a(h), the NRC requires compliance for plant protection and safety systems for design, reliability, qualification, and testability of the power and instrumentation and control portions of the safety systems outlined in RG 1.153. The onsite electrical AC power system equipment with respect to the design of instrumentation and control equipment and circuits is not a protection system and does not perform any safety-related functions. Therefore, the staff finds that the onsite AC system is not required to conform to 10 CFR 50.55a(h) and IEEE Std. 603-1991. SER Section 7.2.13 addresses and provides the staff's evaluation of compliance with 10 CFR 50.55a(h) in regard to monitoring systems.

8.3.1.4.10 Conformance to Regulatory Guide 1.6

RG 1.6 describes an acceptable degree of independence between redundant standby (onsite) power sources and between their distribution systems, as part of compliance with GDC 17. In FSAR Table 8.1-1, RG 1.6 is not applicable nor used as guidance for the onsite AC electric power system design. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As the onsite power sources are non-safety related, independence between the standby power sources and their distribution system is not required. The staff also finds that the onsite AC power systems is not needed to permit the functioning of SSCs important to safety, as the onsite AC power system is not safety related, and therefore, RG 1.6 is not applicable, since there are no Class 1E distribution systems that need to be independent from the standby power sources.

8.3.1.4.11 Conformance to Regulatory Guide 1.32

RG 1.32 pertains to the design, operation, and testing of the safety-related portions of the onsite AC power system. FSAR Table 8.1-1, RG 1.32 is not applicable nor used as guidance for the onsite ac electrical power system design.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The onsite AC power system is not safety related and, therefore, RG 1.32 is not applicable, since RG 1.32 only pertains to the safety-related portions of the onsite AC power system.

8.3.1.4.12 Conformance to Regulatory Guide 1.53

RG 1.53 pertains to the application of the single-failure criterion. FSAR Table 8.1-1, RG 1.53 is not applicable nor used as guidance for the onsite AC electrical power system design.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The onsite AC power system is not safety related and, because the single failure criterion is not applied to systems that are not safety related, RG 1.53 is not applicable.

8.3.1.4.13 Conformance to Regulatory Guide 1.63

RG 1.63 pertains to the capability of EPAs in containment structures to withstand a LOCA without loss of mechanical integrity and the external circuit protection for such penetrations to meet the requirement of GDC 50. Mechanical integrity during and following a LOCA is addressed in SER Sections 3.11 and 6.2.1.

The staff's evaluation and approval of the EPA circuit protection aspects of the NuScale US460 design is discussed in SER Section 8.3.1.4.7.

8.3.1.4.14 Conformance to Regulatory Guide 1.68

FSAR Table 8.1-1 states that RG 1.68 may be used as guidance for the initial test program for the onsite power systems.

SER Section 14.2 describes and evaluates the initial test program for the onsite AC system.

8.3.1.4.15 Conformance to Regulatory Guide 1.75

RG 1.75 pertains to the physical independence of the Class 1E circuits and electrical equipment that comprise or are associated with the onsite AC power system. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The onsite AC power system neither contains nor supports safety-related SSCs, and the staff finds that RG 1.75 is not applicable. SER Chapter 7 evaluates electrical isolation with respect to the module protection system (MPS).

8.3.1.4.16 Conformance to Regulatory Guide 1.81

RG 1.81 provides guidance in support of GDC 5 with respect to the sharing of Class 1E power sources within the onsite AC power system. The staff evaluated the FSAR with respect to RG 1.81 as it relates to the sharing of the AC power sources. The staff concludes, in SER Section 8.3.1.4.3, that the onsite AC power system complies with GDC 5 in that there are no Class 1E circuits in the design. Therefore, RG 1.81 is not applicable to the NuScale US460 design since RG 1.81 only pertains to safety-related systems.

8.3.1.4.17 Conformance to Regulatory Guide 1.106

RG 1.106 provides guidance with respect to thermal overload protection for Class 1E MOVs. In FSAR Table 8-1.1, the applicant stated that the NuScale US460 design does not include safety-related MOVs.This evaluation is discussed in FSER Section 5.4.3. . Therefore, the staff has determined that this RG is not applicable to the onsite AC power system to power any safety-related MOV as there are no safety-related MOVs.

8.3.1.4.18 Conformance to Regulatory Guide 1.118

RG 1.118 pertains to the capability to periodically test the safety-related onsite AC power system (GDC 18).

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The staff also finds that the onsite AC power systems are not needed to permit the functioning of SSCs important to safety. Since RG 1.118 pertains to the safety-related onsite AC power system and the NuScale onsite AC power system is not safety related, the staff finds that RG 1.118 is not applicable.

8.3.1.4.19 Conformance to Regulatory Guide 1.153

The staff evaluated the FSAR with respect to RG 1.153 as it relates to the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety systems of nuclear plants, including the application of the single-failure criterion in the onsite AC power system. As endorsed by RG 1.153, IEEE Std. 603-1991 provides a method acceptable to the staff to evaluate all aspects of the electrical portions of the safety-related systems, including basic criteria for addressing single failures. The SER Chapter 7 discusses the evaluation of IEEE Std. 603-1991 and 10 CFR 50.55a(h).

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The staff also finds that the onsite AC power systems are not needed to permit the functioning of SSCs important to safety.. The onsite AC power system is not safety related and therefore, the staff finds that RG 1.153 is not applicable since the RG applies only to safety-related systems.

8.3.1.4.20 Conformance to Regulatory Guide 1.155

RG 1.155 pertains to the capability and the capacity of the onsite AC power system to accommodate an SBO, including the operation of the auxiliary AC power source. SER Section 8.4 contains the staff evaluation of the SBO capability of the AC power system.

8.3.1.4.21 Conformance to Regulatory Guide 1.204

RG 1.204 endorses IEEE Std. 665-1995 (reaffirmed 2001), IEEE Std. 666-1991 (reaffirmed 1996), IEEE Std. 1050-1996, and IEEE Std. C62.23-1995 (reaffirmed 2001). FSAR Table 8.1-1, RG 1.204 is not applicable nor used as guidance for the onsite AC electric power system design. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The onsite AC power system is not safety related and therefore, the staff finds that RG 1.204 is not applicable and is

one means of compliance with GDC 2. The staff's evaluation to GDC 2 is in Section 8.3.1.4.1 of this SER NuScale US460 design

8.3.1.4.22 Conformance to Regulatory Guide 1.218

RG 1.218 pertains to monitoring the condition of cables that have been determined to fall within the scope of the Maintenance Rule (10 CFR 50.65). FSAR Table 8-1.1 states that RG 1.218 is limited to cables determined within the scope of 10 CFR 50.65. SER Section 17.6 provides the staff's evaluation of the design's compliance with the Maintenance Rule.

8.3.1.4.23 Conformance to Branch Technical Positions

SRP BTP 8-2 states that EDG sets should not be used for peaking service. The intent of SRP BTP 8-2 is to ensure that the provision of GDC 17 is met with respect to minimizing the probability of concurrent loss of electric power sources, which would preclude the use of onsite AC power sources for purposes other than supplying standby power when needed. In FSAR Table 8.1-1, the applicant stated that, because the NuScale US460 design does not rely on AC power sources for the performance of safety-related functions, and the guidance of BTP 8-2 does not need to be applied. Based upon its review, the staff finds that BTP 8-2 is not applicable to the NuScale US460 design, since there are no Class 1E power sources or EDG sets.

SRP BTP 8-6 discusses how adverse effects on the Class 1E loads can be caused by sustained low grid voltage conditions when the Class 1E buses are connected to offsite power. FSAR Section 8.1.3, states that the loss of voltage or degraded voltage condition on the electrical power systems does not adversely affect the performance of plant safety-related functions. Per Section 8.1.2 of this SER, based upon its review, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The staff finds that BTP 8-6 is not applicable since the onsite AC system is not safety related and, therefore, a loss of voltage or degraded voltage condition would not impact the onsite AC system.

SRP BTP 8-9 discusses the electric power system design vulnerability due to open phase conditions in offsite electric power systems. The basis for SRP BTP 8-9 is to provide protection to safety-related AC loads in the event of an open phase condition. SER Section 8.2.4.13 describes and evaluates SRP BTP 8-9.

8.3.1.4.24 Conformance to SECY-91-078, SECY-94-084, and SECY-95-132

SECY-91-078 pertains to the interface between the offsite AC power system and the Class 1E onsite power system. In FSAR, Table 8.1-1, the applicant stated that this guidance does not apply to the NuScale US460 design. This guidance pertains to GDC 17, and the applicant has requested an exemption from GDC 17. Per Section 8.1.2 of this SER, based upon its review, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. Since the onsite AC power system is not safety related, the staff finds that SECY-91-078 is not applicable since it pertains to the interface between the offsite AC power system and the Class 1E onsite system. Neither the onsite or offsite systems of the NuScale design are Class 1E.

DSRS Table 8.11 states that SECY-94-084 and SECY-95-132 provide guidance that relates to the inclusion of an alternate power source to loads that are not safety related for evolutionary plant designs. DSRS Section 8.2.III.3.A states that, for SECY-94-084 and SECY-95-132, the NuScale US460 design review should identify any offsite power requirements to support non-

Class 1E, risk-significant active systems identified through the RTNSS process. SER Section 19.3 further discusses and evaluates the RTNSS..

8.3.1.5 Combined License Information Items

No COL items are provided for this section

8.3.1.6 Conclusion

As set forth above, the staff has reviewed all of the relevant information that is applicable to the NuScale onsite AC power system design and evaluated its compliance with GDC 2; GDC 4; GDC 5; 10 CFR 50.34(f)(2); 10 CFR 50.55a(h); NuScale's requested exemption from GDC 17 and GDC 18 and applicable portions of GDC 33, 34, 35, 38, 41 and 44; GDC 50; and conformance to applicable RGs and standards committed to by the applicant. Based upon its review, the staff concludes that the applicant has provided sufficient information in the FSAR and identified necessary analyses to support the bases for its conclusions on its onsite AC power system design. The staff concludes the design of the NuScale onsite AC power system design meets the appropriate regulatory requirements as discussed in the staff's technical evaluations in Section 8.3.1.4 of this SER. Additionally, the staff has determined that the applicant's request for an exemption from the requirements of GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44, with respect to the onsite AC power system, as discussed in Section 8.1.2 of this SER, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemptions. Where there are changes to the design material to the bases for the exemptions, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.

8.3.2 Direct Current Power Systems

8.3.2.1 Introduction

The onsite DC power systems include the EDAS and the normal DC power system (EDNS). The objective of the NRC staff's review is to determine whether the onsite DC power systems satisfy the requirements of GDC 2, 4, 5, 17, and 18 and will perform their design functions during all plant operating and accident conditions.

8.3.2.2 Summary of Application

FSAR: The applicant provided a system description of the EDAS in FSAR Section 8.3.2.1.1, which is summarized here, in part, as follows.

> The EDAS comprises two DC subsystems that provide a continuous, failure-tolerant source of 125 VDC power to assigned plant loads during normal plant operation and for a specified minimum duty cycle following a loss of AC power. The EDAS-common (EDAS-C) plant subsystem serves plant common loads that have functions that are not specific to a single NPM. These functions include main control room (MCR) emergency lighting and post-accident monitoring (PAM) information displayed in the MCR. The EDAS-module-specific (EDAS-MS) plant subsystem consists of separate and independent DC electrical power supply systems, one for each NPM.

The EDAS-MS consists of four power channels and EDAS-C consists of two power divisions. The EDAS-MS and EDAS-C are capable of providing uninterrupted power to their loads. The EDAS-MS channels A and D have a specified minimum battery duty cycle of 24 hours, and EDAS-MS channels B and C have a specified minimum battery duty cycle of 72 hours. The EDAS-C power divisions have a specified minimum battery duty cycle of 72 hours. The 24-hour battery duty cycle of EDAS-MS channels A and D is specified to preclude unnecessary ECCS valve actuation for a minimum of 24 hours following a postulated loss of AC power, unless a valid ECCS actuation signal is received (Section 6.3.2 contains additional information on ECCS operation). The 72-hour battery duty cycle for EDAS-MS channels B and C and EDAS-C provides a minimum of 72 hours of DC electrical power for MCR normal and emergency lighting and certain equipment supporting PAM. These EDAS-MS and EDAS-C functions are not credited to meet the acceptance criteria for design basis event analyses in Chapter 15. Channel B and Channel C of EDAS-MS also provide power for ECCS hold mode.

The applicant provided a system description on the EDNS in Section 8.3.2.1.2 of the application, which is summarized here, in part, as follows.

The EDNS is a non-Class 1E DC power system classified as nonsafety-related and non-risk-significant. The EDNS does not serve safety-related loads, and it does not have safety-related functional requirements during plant startup, normal operation, shutdown, or abnormal operation.

The EDNS is shared among the NPMs and provides both DC power and AC power (through inverters) to nonsafety-related loads that support functions related to investment protection and power generation (i.e., the loads that are part of plant permanent nonsafety systems).

ITAAC: There are no ITAAC associated with this section of the FSAR.

Technical Specifications: None.

8.3.2.3 Regulatory Basis

Section 8.3.2 of the NuScale DSRS gives the relevant requirements of the Commission's regulations for the onsite DC power systems and the associated acceptance criteria, as summarized below. (DSRS Section 8.3.2 also gives the review interfaces with other DSRS sections.)

- GDC 2, as it relates to SSCs of the DC power system being capable of withstanding the effects of natural phenomena without the loss of the capability to perform their safety functions.
- GDC 4, as it relates to SSCs of the DC power system being protected against dynamic effects, such as the effects of missiles, and to accommodate the effects of environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.
- GDC 5, as it relates to multimodule sharing of the DC power system SSCs.

- GDC 17, as it relates to the onsite DC power system's (1) capacity and capability to permit functioning of SSCs important to safety, (2) independence, redundancy, and testability to perform its safety function assuming a single failure, and (3) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or the loss of power from the transmission network. (The applicant requested an exemption from this criterion.)

- GDC 18, as it relates to inspection and testing of the onsite power systems. (The applicant requested an exemption from this criterion.)

- GDC 33, as it relates to reactor coolant makeup (The applicant requested an exemption from this criterion).

- GDC 34, 35, 38, 41, and 44, as they relate to GDC 17, to ensure that the safety functions so described are accomplished. (The applicant requested an exemption from the electric power provisions of these criteria.)

- GDC 50, as it relates to the design of containment electrical penetrations containing circuits of the AC and DC power system and the capability of EPAs in containment structures to withstand a LOCA without loss of mechanical integrity and the external circuit protection for such penetrations.

- 10 CFR 50.34(f)(2)(xiii), as it relates to Additional TMI Item II.E.3.1. (The applicant requested an exemption from this criterion.)

- 10 CFR 50.34(f)(2)(xx), as it relates to Additional TMI Item II.G.1. (The applicant requested an exemption from this criterion.)

- 10 CFR 50.55a(h), as it relates to the incorporation of IEEE Std. 603-1991, including the correction sheet dated January 30, 1995).

The NRC has the following guidance and acceptance criteria for meeting the above regulatory requirements, per the DSRS:

- RG 1.6, Regulatory Positions D.1, D.3, and D.4, as they relate to the independence between redundant onsite DC power sources and between their distribution systems

- RG 1.32, as it relates to the design, operation, and testing of the safety-related portions of the onsite DC power system

- RG 1.53, as it relates to the application of the single-failure criterion

- RG 1.63, Revision 3, issued February 1987, as it relates to the capability of electric penetration assemblies in containment structures to withstand a LOCA without loss of mechanical integrity and the external circuit protection for such penetrations (GDC 50)

- RG 1.68, as it relates to demonstrating compliance with the NRC regulations as they pertain to initial test programs for light-water-cooled NPPs

- RG 1.75, as it relates to the physical independence of the circuits and electrical equipment that comprise or are associated with the onsite DC power systems

- RG 1.81, as it relates to the sharing of SSCs (power sources) of the DC power system
- RG 1.106, as it relates to safety-related valves
- RG 1.118, as it relates to the capability to periodically test the onsite AC and DC power systems (GDC 18)
- RG 1.128, as it relates to criteria for vented lead-acid storage batteries
- RG 1.129, as it relates to criteria for vented lead-acid storage batteries
- RG 1.153, as it relates to the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety systems of nuclear plants, including the application of the single-failure criterion in the onsite DC power system
- RG 1.155, as it relates to the capability and the capacity of the onsite DC power system for an SBO
- RG 1.212, as it relates to guidance for defining the DC load and size of lead-acid batteries needed to supply the defined load for full-float stationary battery applications to support NPP operations
- RG 1.218, it relates to monitoring the condition of cables that have been determined to fall within the scope of the Maintenance Rule
- SECY-91-078, as it relates to the interface between the onsite AC power system and the offsite power system
- SECY-94-084, as it relates to the policy and technical issues associated with the RTNSS affecting passive plant designs.
- SECY-95-132, as it relates to the policy and technical issues associated with the RTNSS affecting passive plant designs

8.3.2.4 Technical Evaluation

DSRS Section 8.3.2 discusses the relevant requirements of the Commission's regulations for the onsite DC power systems and the associated acceptance criteria. The relevant requirements are discussed in Section 8.3.2.2 of this SER. This section discusses how NuScale has met or addressed those regulatory requirements for EDAS-MS. As the EDNS is non-safety and non-risk significant, the staff's review focuses on EDAS, including EDAS-MS and EDAS-C.

FSAR Section 8.3.2.1.1 states that augmented design requirements are applied to the EDAS batteries and EDAS distribution panels as described in FSAR Table 8.3-2. Therefore, the portions of the EDAS system with augmented provisions are the batteries and distribution panels. The staff's review focuses on the portions of EDAS-MS and EDAS-C that have augmented design requirements. FSAR Section 8.3.2.1.1 states that all channels of EDAS-MS provide power for ECCS hold mode to preclude unnecessary ECCS valve actuation. By letter dated March 28, 2025 (ML25087A221), the applicant stated that each channel within an EDAS-MS division powers the ECCS trip valve solenoids associated with the applicable division of MPS, and FSAR Figure 7.0-9 shows the power supply and auctioneering scheme provided in the MPS power supply to downstream loads (e.g., trip valve solenoids).

FSAR Section 8.3.2.1.1 states that controls over the reliability and availability of the EDAS-MS power circuitry and supply are included in the owner-requirements manual, described in FSAR Section 16.1. The staff's evaluation of the owner-requirements manual is provided in SER Section 16. Further, FSAR Section 8.3.2.1.1 states that EDAS is included in the maintenance rule program in accordance with 10 CFR 50.65. SER Section 17.6 provides the staff's evaluation of the design's compliance with the Maintenance Rule. FSAR Section 8.3.2.1.1 further states that:

> The requirement to include EDAS-MS within the owner-controlled requirements manual, as well as adherence to the requirements inherent to the maintenance rule (i.e., system performance and the requirement to assess and manage risk) ensures that the functionality (availability and reliability) of EDAS-MS is maintained consistent with the Probabilistic Risk Assessment modeling in [FSAR] Section 19.1:
>
> - common cause failure remains the dominant failure
> - reliability is equivalent to a typical Class 1E system
> - test and maintenance unavailability, excluding batteries, is minimal and limited to a single channel
> - test and maintenance unavailability of batteries is negligible.

The staff's evaluation of the applicant's PRA is provided in SER Chapter 19.

Augmented Design Requirements

FSAR Table 8.3-3 provides the specific augmented provisions of the EDAS design. Regarding quality assurance, FSAR Table 8.3-3 states that the graded QA program is in the QA Program Description (QAPD). The staff's evaluation of the QAPD is in SER Chapter 17.

For environmental qualification, the applicant stated in FSAR Table 8.3-3 that the batteries are located in a mild environment and are qualified to IEEE Std. 323-2003. While IEEE Std. 535 pertains to the qualification of vented lead-acid batteries, currently, there is no existing qualification methodology for valve-regulated lead-acid (VLRA) batteries. The staff finds the use of IEEE Std. 323-2003, a consensus standard with good engineering practice, is reasonable for environmental qualification of valve-regulated lead-acid batteries.

Regarding the batteries, in FSAR Table 8.3-3, the applicant states that design and installation is per IEEE Std. 1187-2013; sizing is per IEEE Std. 485-2020 as endorsed by RG 1.212, Revision 2; instrumentations, indication, and alarms is per IEEE Stds. 946-2020, 1491-2012, 1187-2013, 1188-2005 (R2010) with 2014 amendment. The staff addressed sizing in SER Section 8.3.2.4.23. The staff finds the use of IEEE 1187-2013, a consensus standard with good engineering practice, is reasonable for design and installation of VRLA batteries. Further, the staff finds that the use of IEEE Stds. 946-2020, 1491-2012, 1187-2013, 1188-2005 (R2010) with 2014 amendment reasonable for instrumentations, indication, monitoring, and alarms since these standards provide good engineering practice related to instrumentation, indication, monitoring, and alarms.

In FSAR Table 8.3-3, the applicant states that identification and independence is per IEEE Std. 384-1992, with modification per RG 1.75. By letter dated March 28, 2025 (ML25087A222), the applicant stated that divisions of EDAS are not cross-connected or cross-tied, thereby maintaining divisional independence. The staff's evaluation pertaining to the conformance to RG 1.75 is provided in SER Section 8.3.4.15.

In FSAR Table 8.3-3, the applicant states that the single failure criterion is applied to EDAS SSC that provide electrical power to prevent unintended ECCS valve actuation per IEEE 379-2020 as endorsed by RG 1.53 .The staff's evaluation pertaining to the design's conformance to RG 1.53 is provided in SER Section 8.3.2.4.12.

Regarding common-cause failure, NuScale indicated in FSAR Table 8.3-3 that common-cause failure probability is minimized to the extent practicable via, but not limited to, 1) independence, including appropriate use of physical separation and electrical isolation; 2) protection from environmental and dynamic effects of internal equipment failures design requirements; 3) design, environmental qualification, and quality assurance provisions; 4) HVAC systems; 5) protection from natural phenomena; 6) location within SC-1 structures; and 7) battery supply immediately available during normal operations and following loss of power from the AC system. The staff evaluated compliance with GDC 2 and GDC 4 in Sections 8.3.2.4.1 and 8.3.2.4.2, respectively. The staff's evaluation pertaining to independence and the EDAS design's conformance to RG 1.75 is provided in SER Section 8.3.4.15. The staff finds the description for minimizing CCF probability acceptable.

In FSAR Table 8.3-3, the applicant stated that equipment protection and coordination studies are performed in accordance with IEEE Stds. 242-2001, 946-2020, and 1375-1998. Since these consensus standards contain good engineering judgement and practices pertaining to equipment protection, the staff finds the use of these standards reasonable.

Regarding isolation with Class 1E, as discussed in FSAR Table 8.3-3, the staff's evaluation is provided in SER Chapter 7. FSAR Table 8.3-3 states that controls and indication are provided inside and outside the MCR and instrumentation, indication, and alarming features are consistent with IEEE Stds 946-2020, 1491-2012, 1187-2013, 1188-2005 (R2010) with 2014 amendment. As these standards provide good engineering practices related to instrumentation, indication, monitoring, and alarms, the staff finds the description related to the location of instrumentation, indication, and alarms reasonable.

FSAR Table 8.3-3 addresses maintenance, surveillance and testing, such that periodic inspection is performed, preoperational testing is performed according to FSAR Section 14.2, and battery maintenance is performed per IEEE Std. 1188-2005 (R2010) with 2014 amendment. Further, FSAR Section 8.3.2.1.1 states that EDAS is included in the maintenance rule program in accordance with 10 CFR 50.65. SER Section 17.6 provides the staff's evaluation of the design's compliance with the Maintenance Rule. The staff's evaluation of preoperational testing is provided in SER Section 14. The staff finds the use of IEEE Std. 1188-2005(R2010) reasonable for the maintenance of VRLA batteries as it is a consensus standard providing good engineering practices.

Lastly, pertaining to multi-unit station considerations, in Table 8.3-3, the staff's evaluation of the design's compliance with GDC 5 is provided in Section 8.3.2.4.3 of this SER.

On the basis of its review of the EDAS design and the information provided in FSAR Table 8.3-3, the staff considers that the description for the augmented design, qualification, and quality assurance provisions in Table 8.3-3 is acceptable. The staff finds that there is reasonable assurance that the EDAS will function as designed.

8.3.2.4.1 Compliance with GDC 2

Compliance with GDC 2 requires that SSCs important to safety be designed to withstand the effects of natural phenomena such as earthquake, tornado, hurricane, flood, tsunami, or seiche without losing the capability to perform their intended safety functions.

With regard to the DC power system, this criterion requires that important-to-safety portions of the onsite DC power system must be protected from the most severe natural phenomena that historically have been reported for the site and surrounding area. Therefore, the important-to-safety portions of the DC power system are normally located in seismic Category I (SC-I) structures that provide protection from the effects of tornadoes, tornado missiles, and floods.

FSAR Section 8.3.2.2.1 states, in part, the following:

> The EDAS is augmented to comply with GDC 2 requirements for increased reliability and availability. The EDAS structures, systems, and components are located in Seismic Category I areas of the plant, specifically in the Reactor Building and in areas of the Control Building (CRB) that are designed to withstand the effects of and function following natural phenomena such as earthquakes, tornadoes, hurricanes, floods, and externally-generated missiles.
>
> The EDAS structures, systems, and components are further augmented by applying design, qualification, and QA provisions typically applied to Class 1E DC power systems using a graded approach. The graded approach is reflected in the EDAS design, qualification, and QA provisions detailed in this Chapter and the Quality Assurance Program Description. Augmented DC power system SSC that provide backup DC electrical power meet Seismic Category I standards per IEEE Std 344-2013.

The staff finds that the EDAS complies with GDC 2 as the EDAS components are located in SC-I structures.

8.3.2.4.2 Compliance with GDC 4

Compliance with GDC 4 requires SSCs important to safety (1) to be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents and (2) to be appropriately protected against dynamic effects that may result from equipment failures, including missiles.

In FSAR Section 8.3.2.2.1, the applicant stated, in part, the following with regard to GDC 4:

> The EDAS complies with GDC 4 requirements. The EDAS design accommodates the effects of environmental conditions by applying augmented provisions for the design, qualification, and QA typically applied to Class 1E DC power systems using a graded approach. The graded approach is reflected in the EDAS design, qualification, and QA provisions detailed in this Chapter and as described in FSAR Section 17.5. The EDAS is located in a mild environment as defined in 10 CFR 50.49(c), such that it is not subject to the requirements of 10 CFR 50.49. The physical locations of the EDAS-MSs and EDAS-C within the Reactor Building and the CRB, respectively, provide the EDAS with protection from dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids.

> The Reactor and Control Building HVAC systems provide EDAS structures, systems, and components with ventilation including cooling, heating, humidity control, and hydrogen dilution in accordance with Reference 8.3-7, Reference 8.3-8, and Reference 8.3-12. The BPSS delivers backup power to heating, ventilation, and air conditioning systems serving the battery and associated charger rooms to avoid prolonged periods of high ambient temperature.
>
> The EDAS batteries are environmentally qualified per Reference 8.3-13.

The harsh environment is not applicable to the EDAS. The design would meet the same guidance governing environmental qualification for mild environments as that applied to a Class 1E electrical system. The augmented provisions assume that the EDAS will not be located in an area that would experience environmental conditions considered to be a harsh environment. These systems will be located in a “mild environment” as defined in 10 CFR 50.49(c), such that they would not be subject to the requirements of 10 CFR 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants,” for harsh environments.

Since the EDAS will be located in a mild environment, and in the SC-I RXB and CRB, the staff finds there is reasonable assurance that the EDAS meets the requirements of GDC 4.

8.3.2.4.3 Compliance with GDC 5

Compliance with GDC 5 requires that SSCs important to safety not be shared among nuclear power units unless such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

In FSAR Section 8.3.2.2.1, the applicant stated, in part, the following with regard to GDC 5:

> ….the EDAS-MS is not shared among NPMs. Specifically, portions of the EDAS that supply electrical power to the MPS are not shared. Each NPM is provided with a dedicated EDAS-MS. The module-specific subsystem meets the provisions of regulatory position C.1 of Regulatory Guide 1.81 Revision 1, as described in Table 1.9-2.
>
> Sharing of the EDAS-C is shown on Figure 8.3-3. A postulated loss of power or power fluctuation on the EDAS-C would not result in adverse interactions among NPMs, and would not impair the performance of safety-related functions necessary to achieve and maintain safe shutdown of the NPMs.

Because the EDAS-MS is not shared between NPMs, the staff finds that the EDAS-MS meets the requirements of GDC 5.

EDAS-C serves plant common loads that have functions that are not specific to a single NPM, including MCR emergency lighting and PAM information displayed in the MCR, as stated in FSAR Section 8.2.3.1.1. Because the loss of the EDAS-C would not impair the performance of safety-related functions necessary to achieve and maintain safe shutdown and EDAS-C is shared among NPMs, the staff finds the requirements of GDC 5 are not applicable to EDAS-C.

8.3.2.4.4 Compliance with GDC 17

GDC 17 states that an onsite power system (both AC and DC) shall be provided to permit the functioning of SSCs important to safety and that it shall have sufficient independence, redundancy, and testability, assuming a single failure, to support those SSCs in performing their safety functions. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As discussed above, NuScale requested an exemption from GDC 17. The staff considered NuScale's exemption requests and determined that those exemptions, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.3.2.4.5 Compliance with GDC 18

Compliance with GDC 18 requires that electric power systems important to safety be designed to permit appropriate periodic inspection and testing of key areas and features to assess their continuity and the condition of their components. These systems shall be designed to test periodically (1) the operability and functional performance of the components of the systems, such as onsite DC power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practicable, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system.

It is important to note that, although the applicant stated in its application that GDC 18 is not applicable as a requirement, FSA Section 8.3.2.3, states that periodic inspection and testing is performed on the EDAS for operational, commercial, and plant investment protection purposes and the EDAS is designed to permit appropriate periodic inspection and testing to assess the operability and functionality of the systems and the condition of their components. Further, the applicant states that protection devices are capable of being tested, calibrated, and inspected. The staff finds the program as described in FSAR Section 8.3.2.3, to be acceptable since periodic inspection and testing are performed on the EDAS systems.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As discussed above, NuScale requested an exemption from GDC 18. The staff considered NuScale's exemption request and determined that the exemption, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.3.2.4.6 Compliance with GDC 33, 34, 35, 38, 41, and 44

The staff evaluated the FSAR with respect to the operation of the onsite electric power system. GDC 33, 34, 35, 38, 41, and 44 identify plant safety-related functions, including electric power

system requirements for those functions. The NuScale US 460 design accomplishes the safety-related functions addressed by these GDC via passive systems without reliance on electric power.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As discussed above, NuScale requested an exemption from GDC 33, 34, 35, 38, 41, and 44 The staff considered NuScale's exemption requests and determined that those exemptions, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.

8.3.2.4.7 Compliance with GDC 50

Compliance with GDC 50 requires that the reactor containment structure, including access openings, penetrations, and containment heat removal systems, be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any LOCA. Containment electric penetrations must therefore be designed to accommodate, without exceeding their design leakage rate, the calculated pressure and temperature conditions resulting from a LOCA. This criterion applies specifically to ensuring the integrity of containment electrical penetrations in the event of design-basis LOCA conditions. The focus of the Chapter 8 portion of the review of the EPAs is circuit protection. The staff uses RG 1.63 as a guide to evaluate the circuit protection for the circuits that penetrate containment. The structural integrity and environmental qualification aspects of the EPAs are evaluated in Chapter 6 and Chapter 3, respectively, of this SER.

Based upon its review of the design criteria, the staff finds that the EPA circuit protection is in conformance to the provisions of RG 1.63. Specifically, Class 1E circuits are provided with Class 1E protection, non-Class 1E circuits are provided with non-Class 1E protection, and the self-limiting circuits are not provided with circuit protection. Therefore, the staff finds that the NuScale EPA design meets the requirements of GDC 50 with respect to circuit protection and is acceptable.

Circuit protection for the instrumentation and control cables is evaluated in Chapter 7 of this SER.

8.3.2.4.8 Compliance with 10 CFR 50.34(f)(2)(v)

The regulation in 10 CFR 50.34(f)(2)(v) states that the applicant shall provide for automatic indication of the bypassed and operable status of safety systems. The staff evaluated the FSAR with respect to the automatic indication of the bypassed and operable status of safety systems. In FSAR Table 8.1-1, the applicant stated that this requirement is not applicable to the NuScale electric power systems, which are not safety related. SER Section 7.2.13 addresses this item.

Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. The regulation in 10 CFR 50.34(f)(2)(v) and associated guidance apply to safety-related systems and, because

the onsite DC systems, EDAS-MS and EDAS-C, are non-Class 1E systems, the staff finds that 10 CFR 50.34(f)(2)(v) and associated guidance are not applicable.

8.3.2.4.9 Compliance with 10 CFR 50.55a(h)

The staff evaluated FSAR Section 8.3.2, with respect to the incorporation of IEEE Std. 603-1991. The applicant stated in FSAR Table 8.1-1, with regard to 10 CFR 50.55a(h), that NuScale electrical systems are not protection systems and do not perform safety-related functions. The staff finds that, because the EDAS is not safety related, the requirements of 10 CFR 50.55a(h) are not applicable. The staff evaluates compliance with 10 CFR 50.55a(h) with respect to monitoring and protection systems in Chapter 7 of this SER.

8.3.2.4.10 Conformance to Regulatory Guide 1.6

RG 1.6 describes an acceptable degree of independence between redundant standby (onsite) power sources and between their distribution systems, as part of compliance with GDC 17. FSAR Table 8.1-1 states that RG 1.6 is not applicable to onsite DC systems. Per Section 8.1.2 of this SER, based upon its review, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. Since the onsite DC systems are not safety-related, the staff finds that RG 1.6 is not applicable.

8.3.2.4.11 Conformance to Regulatory Guide 1.32

The staff evaluated the FSAR with respect to RG 1.32, as it relates to the design, operation, and testing of the safety-related portions of the onsite DC power system. RG 1.32, Revision 3, endorses IEEE Std. 308-2001. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As the EDAS is not safety-related, the staff finds that RG 1.32 is not applicable to EDAS.

8.3.2.4.12 Conformance to Regulatory Guide 1.53

The staff evaluated the FSAR with respect to RG 1.53, as it relates to the application of the single-failure criterion to the electric power portions of plant safety systems. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems. As the EDAS is not safety-related, the staff finds that RG 1.53 is not applicable to EDAS.

8.3.2.4.13 Conformance to Regulatory Guide 1.63

The staff evaluated the FSAR with respect to RG 1.63 as it relates to the capability of electric penetration assemblies in containment structures to withstand a LOCA without loss of mechanical integrity, and the external circuit protection for such penetrations. RG 1.63 provides one method to meet the requirements of GDC 50. In Table 8.1-1, the applicant states that RG 1.63 is used as guidance for onsite DC systems. The staff's evaluation and approval of the EPA circuit protection aspects with regard to conformance to RG 1.63 is in SER Section 8.3.1.4.13 and compliance with GDC 50 in SER Section 8.3.2.4.7.

8.3.2.4.14 Conformance to Regulatory Guide 1.68

DSRS Table 8.1-1 states that RG 1.68 may be used as guidance for the initial test program for the onsite DC power systems. FSAR Section 8.3.2.2.1, states that the EDAS preoperational

testing is performed as part of the Initial test program described in FSAR Section 14.2.12. SER Section 14.2 evaluates the initial test program for the EDAS.

8.3.2.4.15 Conformance to Regulatory Guide 1.75

The staff evaluated FSAR with respect to RG 1.75, as it relates to the physical independence of the circuits and electrical equipment that comprise or are associated with the onsite DC power system. RG 1.75 discusses the independence of the electrical circuits and does not differentiate between AC and DC power systems. In FSAR Section 8.3.2.2.1, the applicant stated, with regard to RG 1.75, that the physical separation, electrical independence, and identification criteria of RG 1.75 and IEEE Std. 384-1992 are applied to the EDAS as an augmented quality provision. The staff finds that applying RG 1.75 to EDAS is acceptable. The staff evaluates electrical isolation with respect to the MPS in SER Section 7.1.2.4.1.

8.3.2.4.16 Conformance to Regulatory Guide 1.81

The staff evaluated FSAR with respect to RG 1.81, as it relates to the sharing of SSCs of the DC power system. Regulatory Position C.1 of RG 1.81 states that multi-unit sites should not share DC systems. FSAR Table 1.9-2 states that the NuScale US460 design partially conforms to RG 1.81, EDAS-MS meets the provisions of RG 1.81 Regulatory Position C.1, Regulatory Position C.2 is not appliable since the design does not include emergency AC power, Regulatory Position C.3 is not applicable because the design does not include emergency power systems, and EDAS-MS is not shared between modules.

8.3.2.4.17 Conformance to Regulatory Guide 1.106

RG 1.106 provides guidance with respect to thermal overload protection for Class 1E MOVs. In FSAR Table 8-1.1, the applicant stated that the NuScale US460 design does not include safety-related MOVs. Therefore, the staff determined that RG 1.106 does not apply to EDAS, as it has no safety-related MOVs.

8.3.2.4.18 Conformance to Regulatory Guide 1.118

The staff evaluated the FSAR with respect to RG 1.118, as it relates to the capability to periodically test the onsite DC power system. It is important to note that, although the applicant stated in FSAR Table 8-1.1 that RG 1.118 is not applicable to EDAS, FSAR Section 8.3.2.3, states that periodic inspection and testing is performed on the EDAS for operational, commercial, and plant investment protection purposes and the EDAS is designed to permit appropriate periodic inspection and testing to assess the operability and functionality of the systems and the condition of their components. The staff finds the program as described in FSAR Section 8.3.2.3, to be acceptable since periodic inspection and testing are performed on the EDAS systems.

8.3.2.4.19 Conformance to Regulatory Guide 1.128

The staff evaluated the FSAR with respect to RG 1.128, as it relates to the installation of vented lead acid- storage (VLA) batteries in the onsite DC power system. In FSAR Table 8-1.1, the applicant stated with regard to RG 1.128, that vented lead-acid batteries are not included in the design. The staff finds RG 1.128 is not applicable to the EDAS system because RG 1.128 relates to VLA batteries and the NuScale US460 design uses VRLA batteries rather than VLA batteries. The installation of VRLA batteries is addressed in IEEE Std. 1187-2013, “IEEE Recommended

Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications," which the applicant is applying to the NuScale US460 design.

8.3.2.4.20 Conformance to Regulatory Guide 1.129

The staff evaluated the FSAR with respect to RG 1.129, as it relates to maintenance, testing, and replacement of VLA storage batteries in the onsite DC power system. As stated above, in FSAR Table 8-1.1, the applicant stated with regard to RG 1.129, that vented lead-acid batteries are not included in the design. The staff finds RG 1.129 is not applicable to the EDAS system because RG 1.129 relates to VLA batteries, and the NuScale US460 design uses VRLA batteries rather than VLA batteries. The maintenance, testing, and replacement of VRLA batteries is addressed in IEEE Std. 1188-2005, (R2010) with 2014 amendment "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications," which the applicant is applying to the NuScale US460 design, as stated in FSAR Table 8.3-3.

8.3.2.4.21 Conformance to Regulatory Guide 1.153

The staff evaluated the FSAR respect to RG 1.153, as it relates to the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety systems of nuclear plants, including the application of the single-failure criterion in the onsite DC power system. As endorsed by RG 1.153, IEEE Std. 603-1991 provides a method acceptable to the staff to evaluate all aspects of the electrical portions of safety-related systems, including basic criteria for addressing single failures. In FSAR Table 8-1.1, the applicant stated that RG 1.153 is not applicable and not used as guidance for the onsite DC power system. Further, the applicant noted that the system boundary between the nonsafety-related EDAS and the safety-related MPS is at the Class 1E isolation device, and the isolation device is considered part of MPS. The staff finds that RG 1.153 is not applicable since EDAS is non-safety related.

The staff evaluates the FSAR with regard to the MPS, IEEE Std. 603-1991 and 10 CFR 50.55a(h) in Chapter 7 of this SER.

8.3.2.4.22 Conformance to Regulatory Guide 1.155

RG 1.155 relates to the capability and the capacity of the onsite DC power system to withstand and recover from an SBO. The staff evaluates conformance to RG 1.155 in SER Section 8.4.

8.3.2.4.23 Conformance to Regulatory Guide 1.212

The staff evaluated the FSAR with respect to RG 1.212, as it relates to the sizing of large lead-acid storage batteries. In FSAR Table 8.1-1, NuScale states that RG 1.21, Revision 2 is used as guidance for the onsite DC systems and the EDAS batteries are sized in accordance with IEEE Std. 485-2020. FSAR Table 8.3-3 states that sizing of the EDAS batteries is per IEEE 485-2020, as endorsed by RG 1.212, Revision 2. Although the NuScale US460 design uses VRLA batteries, the staff finds that defining the DC load and size of lead-acid batteries is applicable to VRLA batteries, and thus RG 1.212 can be used. The staff finds NuScale conforms to RG 1.212, as NuScale is applying IEEE Std. 485-2020.

8.3.2.4.24 Conformance to Regulatory Guide 1.218

The staff evaluated the FSAR with respect to RG 1.218, as it relates to the condition monitoring techniques of electric cables within the scope of the Maintenance Rule. In FSAR Table 8-1.1, the applicant stated that its use of RG 1.218 is limited to cables determined to be within the scope of 10 CFR 50.65.

The staff reviewed the applicant's strategy to address the Maintenance Rule requirement (10 CFR 50.65) described in FSAR Section 17.6 because the description of a Maintenance Rule program is the COL applicant's responsibility, the staff finds that deferring consideration of the guidance in RG 1.218 to the COL is acceptable.

8.3.2.4.25 Conformance to SECY-91-078, SECY-94-084, and SECY-95-132

SECY-91-078 pertains to the interface between the offsite AC power system and the Class 1E onsite power system. In FSAR Table 8.11, the applicant stated- that the guidance does not apply to the NuScale US460 design. This guidance pertains to GDC 17, and the applicant has requested an exemption from GDC 17, as described in SDAA Part 7. Per Section 8.1.2 of this SER, the staff finds that the onsite electric power systems do not warrant a Class 1E designation and are not safety-related systems.
Since the onsite DC power system is not safety related, the staff finds that SECY-91-078 is not applicable.

DSRS Table 8.1-1 states that SECY-94-084 and SECY-95-132 provide guidance that relates to the inclusion of an alternate power source to loads that are not safety related at evolutionary plant designs. DSRS Section 8.2.III.3.A states that, for SECY-94-084 and SECY-95-132, the NuScale design review should identify any offsite power requirements to support non-Class 1E, risk-significant active systems identified through the RTNSS process. As discussed in SER Section 19.3, no SSCs in the NuScale design are determined to meet the RTNSS criteria. Accordingly, the staff has determined that SECY-94-084 and SECY-95-132 are not applicable.

8.3.2.5 Combined License Information Items

No COL items are provided for this section.

8.3.2.6 Conclusion

As set forth above, the staff has reviewed all of the relevant information that is applicable to the NuScale onsite DC power system design and evaluated its compliance with GDC 2; GDC 4; GDC 5; the requested exemption from GDC 17, GDC 18, and applicable portions of GDC 33, 34, 35, 38, 41, and 44; GDC 50; 10 CFR 50.34(f); 10 CFR 50.55a(h); 10 CFR 52.137(a)(15); and conformance to applicable RGs and standards committed to by the applicant. The staff concludes that the applicant has provided sufficient information in the SDAA and identified necessary analyses to support the bases for its conclusions for its onsite DC power system design. The staff concludes the design of the NuScale onsite DC power system meets the appropriate regulatory requirements listed in FSAR Section 8.3.2.2, "Design Evaluation," as shown in the staff's technical evaluations in Section 8.3.2.4 of this SER. Additionally, the staff considered the applicant's request for an exemption from the requirements of GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44, with respect to the onsite DC power system, and determined that those exemptions, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA,

would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

8.4 Station Blackout

8.4.1 Introduction

In 10 CFR 50.2, an SBO is defined as a complete loss of AC electric power to the essential and nonessential switchgear buses in the NPP (i.e., loss of offsite electric power system concurrent with turbine trip and unavailability of the onsite emergency ac power system). For the NuScale US460 design, an SBO involves a loss of the offsite electric power system (preferred power system) concurrent with a turbine trip. An SBO does not include loss of available AC power to buses fed by station batteries through inverters or by AAC sources specifically provided for SBO mitigation. The staff reviewed the applicant's design to verify that the plant is capable of withstanding and recovering from a complete loss of AC electric power for a minimum of 72 hours, as described in the FSAR. The staff also reviewed and evaluated the application to determine its compliance with the requirements of 10 CFR 52.137(a)(15) and conformance to the applicable guidance.

8.4.2 Summary of Application

FSAR: The applicant has provided a system description in FSAR Section 8.4, summarized, in part, as follows:

> The NuScale Power Module (NPM) design does not rely on onsite or offsite AC power for the performance of safety-related functions during a design basis event. As a result, emergency onsite AC power is not included in the design.
>
> The SBO duration for passive plant designs is 72 hours pursuant to Nuclear Regulatory Commission policy provided by SECY-94-084 and SECY-95-132 and the associated staff requirements memoranda. Passive plants are required to demonstrate safety-related functions can be performed without reliance on AC power for 72 hours after the initiating event.

ITAAC: There are no ITAAC associated with FSAR Section 8.4.

Technical Specifications: There are no technical specifications for this area of review.

8.4.3 Regulatory Basis

DSRS Section 8.4 provides the relevant NRC requirements for this area of review and the associated acceptance criteria for NuScale's plant design, as summarized below. DSRS Section 8.4 also provides review interfaces with other DSRS sections.

The following regulations establish the applicable requirements:

- 10 CFR 50.63, as it relates to the capability to withstand and recover from an SBO
- 10 CFR 52.137(a)(16), as it relates to the capability to withstand and recover from an SBO

- GDC 17, as it relates to the onsite AC power system's (1) capacity and capability to permit functioning of SSCs important to safety, (2) independence, redundancy, and testability to perform its safety function assuming a single failure, and (3) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or the loss of power from the transmission network

- GDC 18, as it relates to the inspection and testing of the onsite power systems

The applicant requested an exemption from GDC 17 and 18.

The following documents provide additional criteria or guidance in support of the DSRS Section 8.4 acceptance criteria to meet the above requirements:

- RG 1.155, as it relates to compliance with 10 CFR 52.137(a)(16) and 10 CFR 50.63

- SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," and SECY-94-084, as they relate to the use of AAC power sources and the RTNSS process at plants that have passive safety systems

- SECY-95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084)," dated May 22, 1995, relates to the policy and technical issues associated with the RTNSS affecting passive plant designs.

- RG 1.75, as it relates to the independence of SBO-related power sources and distribution systems between the onsite and offsite AC power systems, especially the isolation capability of the battery chargers for the DC system

8.4.4 Technical Evaluation

The staff reviewed FSAR Section 8.4 to determine whether the design is capable of withstanding and recovering from an SBO as required by 10 CFR 52.137(a)(16). The SBO duration for passive plant designs is 72 hours, which is consistent with the NRC's policy in SECY-94-084 and SECY-95-132 and the associated staff requirements memoranda.

8.4.4.1 Compliance with 10 CFR 50.63, 10 CFR 52.137(a)(16) and Conformance to Regulatory Guide 1.155

Under 10 CFR 50.63, the NRC requires that each NPP be capable of withstanding or coping with, and recovering from, an SBO of a specified duration (known as coping duration) and of maintaining adequate core cooling and appropriate containment integrity for the SBO coping duration. RG 1.155 provides guidance for implementing the SBO requirements of 10 CFR 50.63. Under 10 CFR 52.137(a)(16), the NRC requires that each NPP be capable of withstanding or coping with, and recovering from, an SBO of a specified duration (known as the coping duration) and of maintaining adequate core cooling and appropriate containment integrity for the SBO coping duration. RG 1.155 provides guidance for implementing the SBO requirements of 10 CFR 52.137(a)(16). DSRS Section 8.4 states that, for new advanced light-water-reactor design applications, such as the NuScale application, that use passive safety systems and do not include a spare, full-capacity AAC power source for coping with an SBO, (1) all safety-related functions should be performed without relying on AC power for 72 hours

after the initiating event, and (2) the applicant has implemented, as appropriate, an RTNSS process that conforms to RG 1.206, Section C.IV.9, “Regulatory Treatment of Nonsafety Systems.” RG 1.155 and DSRS Section 8.4 describe an approach acceptable to the staff for meeting the requirements of 10 CFR 50.63 and 10 CFR 52.137(a)(16) that will be applied to the NuScale US460 design.

In FSAR Section 8.4.1, the applicant stated that SBO does not pose a significant challenge to the plant, which does not rely on AC power for performing safety functions. Further, the applicant stated that a safe and stable shutdown is automatically achieved and maintained for 72 hours without operator actions. SER Chapter 15 contains the staff’s review of the acceptance criteria for anticipated operational occurrences and long-term cooling, as they pertain to 10 CFR 50.63 and 10 CFR 52.137(a)(16). The staff finds that the NuScale US460 design complies with 10 CFR 50.63 and 10 CFR 52.137(a)(16) because the applicant demonstrated that safety-related functions can be performed without reliance on AC power for a minimum of 72 hours following an SBO event, as discussed in SER Chapter 15.

FSAR Table 8.1-1 states that 10 CFR 50.63 is applicable to FSAR Section 8.4, RG 1.155 is used as guidance for FSAR Section 8.4 and that compliance with 10 CFR 52.137(a)(16) is shown without the use of RG 1.155.

8.4.4.2 Compliance with GDC 17

GDC 17 states that AC onsite power shall be provided to permit the functioning of SSCs important to safety and electric power from the onsite AC electric power supplies to the onsite distribution system.

SDAA Part 7 discusses the applicant’s request for an exemption from GDC 17. SDAA Part 7, Section 4.2.1, states that safety-related functions are achieved and maintained with no reliance on electric power. Furthermore, FSAR Section 8.3 states that the design does not rely on AC or DC power systems, and that this position is supported by the GDC 17 exemption, as discussed in SER Section 8.1.4.

8.4.4.3 Compliance with GDC 18

GDC 18 relates to the inspection and testing of electric power systems important to safety.

In SDAA Part 7, the applicant stated that the electric power supply systems do not contain any safety-related or risk-significant SSCs that are required to meet GDC 18, and that the AC and DC power systems are not safety related and are non-Class 1E systems. Furthermore, FSAR Section 8.3 states that the design does not rely on AC or DC power systems.

8.4.4.4 Conformance to the Guidelines of SECY-90-016 and SECY-94-084

The guidelines and criteria of SECY-90-016, as they relate to the use of AAC power sources, pertain to evolutionary advanced light-water-reactor designs and do not directly apply to passive plant designs.

For meeting the guidelines and criteria of SECY-94-084 as they relate to the RTNSS at plants with passive safety systems, the applicant stated in FSAR Section 8.4.2 that the equipment described in FSAR Sections 9.2.5, 15.10, and 15.2.6 relied upon to meet 10 CFR 50.63 is passive, safety related, and environmentally qualified. The staff considers this acceptable because safety-related equipment is relied on to mitigate an SBO, as discussed in the SER

Chapter 15 ; therefore, SECY-90-0-16 and SECY-94-084 do not apply to the NuScale US460 design for an SBO. The staff further discusses and evaluates this in SER Chapter 19.

8.4.4.5 Conformance to Regulatory Guide 1.75

The guidance in RG 1.75 pertains to the independence of SBO-related power sources and distribution systems between the onsite and offsite AC power systems. In FSAR Section 8.4, the applicant stated that the NPM design does not rely on the use of onsite or offsite AC power for the performance of safety-related functions for any DBE. Although the SBO-related power sources and distribution systems neither contain nor support safety-related SSCs, the applicant has stated that it will use the separation criteria in RG 1.75 to maintain separation between the non-Class 1E power system and the Class 1E circuits within the MPS. The staff finds this acceptable for the SBO-related power sources. SER Section 7.1.2.4.2 evaluates electrical isolation with respect to the MPS.

8.4.5 Combined License Information Items

No COL items are provided for this section.

8.4.6 Conclusion

Based on the staff's review, the staff finds that the NuScale US460 design for electric systems is acceptable because the applicant demonstrated that safety-related functions can be performed without reliance on AC power for a minimum of 72 hours following an SBO event. This demonstration was performed in a manner consistent with 10 CFR 50.63, RG 1.155, Regulatory Position C.3.2, and meets the requirements of 10 CFR 52.137(a)(16). Additionally, the staff considered the applicant's request for an exemption from the requirements of GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 with respect to SBO, as discussed in SER Section 8.1.4 and determined that those exemptions, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemptions.