

December 2, 2022

Docket No. 99902078

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Submittal of White Paper, "Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)"

This letter transmits NuScale Power, LLC's (NuScale) white paper, "Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)." The purpose of this submittal is to show why NuScale's EDAS should remain classified as a nonsafety-related system.

Enclosure 1 is the proprietary version of this white paper. NuScale asks that the proprietary version be withheld from public disclosure in accordance with 10 CFR § 2.390. Enclosure 3 is the affidavit in support. Enclosure 2 is the nonproprietary version of the white paper.

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments.

If you have questions, please contact Mark Shaver at 541-360-0630 or at mshaver@nuscalepower.com.

Sincerely,



Mark W. Shaver
Manager, Licensing
NuScale Power, LLC

Distribution: Michael Dudek, NRC
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- Enclosure 1: White Paper, "Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)," WP-130033, Revision 0, proprietary version
- Enclosure 2: White Paper, "Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)," WP-130033, Revision 0, nonproprietary version
- Enclosure 3: Affidavit of Mark W. Shaver AF-129767

Enclosure 1:

White Paper, "Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)," WP-130033, Revision 0, proprietary version

Enclosure 2:

White Paper, "Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)," WP-130033, Revision 0, nonproprietary version

Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)

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1. Executive Summary

NuScale Power is making some changes to its approved design. One is a change to the emergency core cooling system (ECCS), allowing it to activate more quickly. The ECCS change results in an overall improvement in safety to the public when compared to the approved design.

The staff believes the ECCS change requires re-classifying the augmented DC power system (EDAS) to be a safety-related system subject to additional regulation.

Chapter 15 analyses (deterministic analyses of postulated events) typically require analyses that assume the failure of nonsafety-related systems. The point at issue here is if those analyses should be done for an EDAS failure at the initiation of the event, or if the analysis should be done assuming a “smart failure,” (*i.e.*, systems fail at the worst possible moment during an event). A “smart failure” is extraordinarily unlikely. The staff assert that a “smart failure” may require the EDAS to be reclassified as a safety-related system.

Re-classifying EDAS would be unnecessary for at least two reasons:

- Commission precedent allows risk-informed principles to be used when strict, prescriptive applications of deterministic criteria are unnecessary to show “reasonable assurance of adequate protection” of safety;
- NRC regulations and guidance place an EDAS smart failure event in the beyond design basis event (BDBE) range or beyond consideration altogether.

Either of these reasons is sufficient to allow EDAS to remain classified as a nonsafety-related system.

2. Background

The Commission previously approved NuScale’s twelve module, 50 MWe design. The highly reliable DC power system (EDSS) in the approved design is classified as nonsafety-related.

NuScale will soon apply for approval of a six module plant using an updated (77 MWe) module. The successor to the EDSS in the six module plant is the augmented DC power system (EDAS).

In the EDAS “smart failure” event, although MCHFR may be exceeded for a few seconds, there is no sustained cladding heat-up, no core damage with loss of coolable geometry, no challenge to containment design pressure, no event exceeding 10 CFR 50.34 dose limits, nor is it an event triggering 10 CFR 50.2’s definition of “safety-related.”²

Nevertheless, the staff believes this scenario is unacceptable, as it may not meet a strict, prescriptive application of a deterministic criterion. Meeting that strict, prescriptive deterministic criterion would require reclassifying a nonsafety-related system to safety-related. The only benefit from the reclassification would be to protect against exceeding MCHFR for a few seconds based on a non-mechanistic “smart failure” of the entire system, an event with a frequency on the order of {{ }}^{2(a)(c)} and would not result in radiological releases challenging the established limits for protecting public health and safety.

3. The requirements of SRM-SECY-19-0036 (IAB valves) apply here

The events leading up to SRM-SECY-19-0036 are instructive and parallel the EDAS classification issue.

In the original, approved design, NuScale used a type of valve with a passive inadvertent actuation block (IAB) component in its emergency core cooling system (ECCS) valves. NRC staff contended that NuScale was to consider the IAB component as an active failure when applying the single failure criterion, a requirement beyond the scope of NuScale’s design basis event analyses. NuScale took the position that the ECCS, in the context of an integrated system, met reasonable assurance of adequate protection, regardless of the application of the deterministic single failure criterion.

The Commission resolved the issue by finding that in any licensing review or other regulatory decision, risk-informed principles should be applied when strict, prescriptive applications of deterministic criteria are unnecessary to provide reasonable assurance of adequate protection of public health and safety.³

The ECCS modifications leading to the change discussed here improve plant safety overall. The chance of an EDAS “smart failure” is very low, and even if it did happen, it is highly likely there would not be any actual core damage. Therefore, in the context of an integrated system, the EDAS “smart failure” is a deterministic criterion unnecessary to protect public health and safety. For that reason, NuScale asks that risk-informed principles be applied rather than a strict, prescriptive application of an EDAS “smart failure.” NuScale will instead demonstrate that SAFDLs are met for all AOOs with EDAS unavailable from the time of event initiation and for the duration of the event analysis.

² The safety function of the ECCS valves is to open to provide core cooling. Maintaining the valves closed, while important for normal operation, is not a safety function.

³ SRM-SECY-19-0036 (ML19183A408) (July 2, 2019)

	SRM-SECY-19-0036 (IAB)	EDAS “smart failure”
Deterministic criterion	Single failure criterion	EDAS “smart failure”
Strict, prescriptive application	Failure to close on demand	Non-mechanistic failure during event progression
Consequence	Failure does not lead to core damage	Failure does not realistically lead to core damage
Overall design provides reasonable assurance of adequate protection	Yes. Very low CDF/LRF	Yes. Very low CDF/LRF
Application of risk-informed principles	Do not assume active failure of IAB to close	Do not assume a “smart failure” of EDAS

4. EDAS “smart failure” is, at most, a beyond design basis event (BDBE)

According to the regulations (10 CFR 50.2), safety-related systems “are relied upon” 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 [unacceptably high] offsite exposure

during “design basis events” (DBEs). Because the safety-related classification requires knowing what events each system is protecting against, determining “safety-related” first requires determining the plant’s DBEs, including the initial conditions.

ANS-51.1/N18.2-1973, “Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plant” can be fairly called the foundational safety analysis basis. It was developed in parallel to and in harmony with the Atomic Energy Commission as it honed its original licensing rules and standards, including the General Design Criteria. As previously stated by the NRC staff, “ANS-51.1/N18.2-1973 constitutes a known and established standard that has been reflected in NRC guidance documents and in the licensing basis of each U.S. nuclear power plant.”⁴

ANS-51.1/N18.2-1973 notes that “the full spectra of plant conditions are identified in accordance with their anticipated frequency of occurrence and consequences,”⁵ and that is important in performing the safety analysis.

For each considered occurrence, the analysis must account for all variations listed in 4.1 to 4.4 below to the extent they are pertinent... Initial conditions at the time of incident or

⁴ Holahan, et al., “Report of the Backfit Appeal Review Panel Chartered by the Executive Director for Operations to Evaluate the June 2016 Exelon Backfit Appeal,” at page 18 (ML16236A208) (August 2016)

⁵ ANS-51.1/N18.2-1973, “Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plant,” at § 2.1.

fault initiation including, but not restricted to, the effects of... (5) status of power systems (for example, electrical, air, hydraulic)...⁶

Considering the status of EDAS as available or unavailable as an initial condition is what NuScale is proposing. NuScale believes its proposal is appropriate given the extremely low probability of the single failure proof EDAS failing in a narrow window of time during an already unlikely reactivity insertion incident.

In 1983, ANSI/ANS rewrote ANS-51.1/N18.2 and developed ANSI-ANS-51.1-1983. The NRC staff gives ANS-51.1-1983 credence and acknowledges licensees' wide use of the standard.⁷

The 1983 version further supports NuScale's proposal. For nonsafety-related equipment, a failure would be addressed as a "coincident occurrence." The standard expressly allows a probabilistic approach:

3.2.3 Optional Approach. As an option to 3.2.1.g and 3.2.2, a probabilistic assessment may be performed to determine the likelihood of the combination of the initiating occurrence plus a single failure or coincident occurrences, or both. Best-estimate values shall be the basis for compliance with this alternative.

This event shall then be categorized as a PC in accordance with the frequency ranges defined in Table 3-1, and the corresponding nuclear safety criteria shall apply. If the frequency of occurrence of an event is shown to be $<10^{-6}$ /reactor year on a best-estimate basis, this event shall not be considered for design.¹⁰ If this optional approach is used, the designer shall indicate this in any statement regarding compliance with this standard.

The risk-informed principles of ANS-51.1 continue in more recent standards:

- ANSI-ANS-58.14-2011,⁸ § 4.5.2, (low probability events [such as "smart failure" of EDAS] considered not credible)
- ANSI-ANS-30.3-2022, § 5.2.1.1 (same)
- NEI 18-04,⁹ at the safety classification flowchart on page 32 (results in "smart failure of EDAS being, at most, a beyond design basis event (BDBE))

⁶ *Id.* at §§ 4, 4.1 (emphasis added).

⁷ e.g., NUREG-0800, Chapter 15.0, at page 15.0-2 (ML070710376) (2007) (describing ANS-51.1-1983 as "commonly used, oft-cited but unofficial"); NRC Regulatory Issue Summary 2005-29, "Anticipated Transients That Could Develop Into More Serious Events," (noting that "Many licensees have incorporated ANS 51.1," and referencing, with approval, ANS-51.1-1983's "non-escalation criterion") (Dec. 2005); cf. AP-1000's Design Control Document, Chapter 15.0 at §§ 15.0.1, 15.0.16 (citing the 1973 version) (ML11171A367) (2011).

⁸ The ANS/ANSI-58.14-2011 standard is cited extensively in DG-1371(ML20168A883). DG-1371 qualifies its reliance on the standard, but none of the qualifications affect this analysis.

⁹ "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," NEI 18-04 (rev 1) at 6 (ML19241A472) (Aug. 2019). NRC endorsed NEI

Thus, NuScale's proposal to analyze the status of EDAS as an initial condition (rather than a "smart failure") is consistent with nearly fifty years of standards and guidance. NuScale's proposal meets regulatory requirements, including 10 CFR 50.2 and the GDCs, by analyzing AOOs with EDAS unavailable from event initiation. This approach demonstrates that EDAS is not "relied upon" to perform safety functions during an AOO. On the other hand, the specific "smart failure" postulated event sequences at issue are too unlikely to be considered as an AOO.

5. Conclusion

The EDAS should remain as nonsafety-related with augmented quality: (1) risk-informed principles should be used when strict, prescriptive application of deterministic criteria are unnecessary to provide reasonable assurance of adequate protection, (2) changing a design to be more safe should be encouraged, (3) the event frequency is on the order of {{
}}^{2(a)(c)}, a frequency that should not require additional regulatory burden,¹⁰ and (4) precedent supports not taking worst-case scenario "smart failures" of nonsafety-related single failure proof systems.

6. References

1. 10 CFR 50.2
2. SRM-SECY-19-0036 (ML19183A408) (July 2, 2019)
3. ANS-51.1/N18.2-1973, *Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plant* (1973)
4. ANSI-ANS-51.1-1983, *Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plant* (1983)
5. Holahan, et al., "Report of the Backfit Appeal Review Panel Chartered by the Executive Director for Operations to Evaluate the June 2016 Exelon Backfit Appeal," (ML16236A208) (August 2016)
6. NUREG-0800, Chapter 15.0, (ML070710376) (2007)
7. NRC Regulatory Issue Summary 2005-29, "Anticipated Transients That Could Develop Into More Serious Events," (Dec. 2005)
8. AP-1000's Design Control Document, Chapter 15.0, (ML11171A367) (2011)

18-04 in RG 1.233 at 13 (ML20091L698) (June 2020), with clarifications not affecting this analysis. NEI 18-04 is technology-neutral, and while the title says "non-LWR," nothing in the body of NEI 18-04 nor its endorsing document, RG 1.233, forbid its use with LWRs.

¹⁰ e.g., 51 Fed. Reg. 30,028, 30,031, Aug. 21, 1986, "Safety Goals for the Operation of Nuclear Power Plant; Policy Statement; Correction and Republication" (one in a 1,000,000 reactor years); Memorandum to the Commissioners, "Alternative Risk Metrics for New Light-Water Reactor Risk-Informed Applications," and enclosed "White Paper on Options for Risk Metrics for New Reactors," (ML090150636, ML090160004) (Feb. 12, 2009) (same)

9. ANSI/ANS-58.14-2011, “Safety and Pressure Integrity Classification Criteria for Light Water Reactors” (2011)
10. ANSI/ANS-30.3-2022, “Light Water Reactor Risk-Informed, Performance-Based Design” (2022)
11. NEI 18-04 rev. 1, “Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development,” (ML19241A472) (Aug. 2019)
12. Regulatory Guide 1.233, “Guidance For a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors” (ML20091L698) (June 2020)
13. 51 Fed. Reg. 30,028, 30,031, “Safety Goals for the Operation of Nuclear Power Plant; Policy Statement; Correction and Republication” (Aug. 21, 1986)
14. Memorandum to the Commissioners, “Alternative Risk Metrics for New Light-Water Reactor Risk-Informed Applications,” and enclosed “White Paper on Options for Risk Metrics for New Reactors,” (ML090150636, ML090160004) (Feb. 12, 2009)

Enclosure 3:

Affidavit of Mark W. Shaver AF-129767

NuScale Power, LLC

AFFIDAVIT of Mark W. Shaver

I, Mark W. Shaver, state as follows:

- (1) I am the Licensing Manager of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure and am authorized to apply for its withholding on behalf of NuScale
- (2) I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
 - (a) The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
 - (b) The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
 - (c) Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
 - (d) The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
 - (e) The information requested to be withheld consists of patentable ideas.
- (3) Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying white paper reveals distinguishing aspects about the method by which NuScale develops its risk analysis.

NuScale has performed significant research and evaluation to develop a basis for this method and has invested significant resources, including the expenditure of a considerable sum of money. The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.
- (4) The information sought to be withheld is in the enclosed white paper, "Treatment of the Augmented DC Power System (EDAS) after safety-enhancing changes are made to the Emergency Core Cooling System (ECCS)." The enclosure contains the designation "Proprietary" at the top of each page. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document. A nonproprietary version is also being submitted.

- (5) The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
- (6) Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
- (a) The information sought to be withheld is owned and has been held in confidence by NuScale.
 - (b) The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
 - (c) The information is being transmitted to and received by the NRC in confidence.
 - (d) No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
 - (e) Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 12/2/2022.



Mark W. Shaver