LO-124940



September 1, 2022

Docket No. 99902043

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

- **SUBJECT:** NuScale Power, LLC Submittal of Presentation Materials Entitled "Emergency Planning Zone (EPZ), Licensing Topical Report (LTR), ACRS Subcommittee Meeting, September 8, 2022," PM-120945, Revision 0 (Open Session)
- **REFERENCES: 1.** NuScale Power, Topical Report "Methodology for Establishing the Technical Basis for Plume Exposure Emergency Planning Zones at NuScale Small Modular Reactor Plant Sites," TR-0915-17772, Revision 3, dated June 10, 2022 (ML22161B010)
 - NuScale Letter to NRC, "Methodology for Establishing the Technical Basis for Plume Exposure Emergency Planning Zones," TR-0915- 17772, Revision 2, dated August 4, 2020 (ML20217L423)

This submittal provides NuScale's presentation materials for the September 8 meeting of the Advisory Committee on Reactor Safeguards (ACRS) subcommittee. The materials support NuScale's presentation of the topical report, "Methodology for Establishing the Technical Basis for Plume Exposure Emergency Planning Zones at NuScale Small Modular Reactor Plant Sites," TR-0915-17772, Revision 3 (Reference 1).

The enclosure to this letter is the nonproprietary version of the presentation entitled "Emergency Planning Zone (EPZ), Licensing Topical Report (LTR), ACRS Subcommittee Meeting, September 8, 2022," PM-120945, Revision 0.

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

If you have any questions, please contact Liz English at 541-452-7333 or at eenglish@nuscalepower.com.

Sincerely,

Mart W. Shares

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- Enclosure: "Emergency Planning Zone (EPZ), Licensing Topical Report (LTR), ACRS Subcommittee Meeting, September 8, 2022," PM-120945, Revision 0 (Open Session)



Enclosure:

"Emergency Planning Zone (EPZ), Licensing Topical Report (LTR), ACRS Subcommittee Meeting, September 8, 2022," PM-120945, Revision 0 (Open Session)



NuScale Nonproprietary

Emergency Planning Zone (EPZ)

Licensing Topical Report (LTR) ACRS Subcommittee Meeting (Open Session)

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September 8, 2022

Liz English, Licensing Supervisor Jeremiah Doyle, EPZ Technical Lead, PRA



Acknowledgement and Disclaimer

This material is based upon work supported by the Department of Energy under Award Number DE-NE0008928.

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Agenda

- Purpose
- Introduction
- Overview of NuScale topical report TR-0915-17772, Revision 3
- Summary





Purpose

- Present content of NuScale topical report TR-0915-17772, Revision 3
- Provide a general understanding of the NuScale method to identify a spectrum of accident sequences and the associated severe accident and dose consequence analyses that form the basis for sizing plume exposure pathway (PEP) emergency planning zones (EPZs) surrounding NuScale plant sites





Introduction

- Topical report provides a method for determining the size of the off-site PEP EPZ surrounding NuScale plant sites
- Applicable to NuScale small module reactor (SMR) designs only
- Consistent with the technical basis in NUREG-0396 and WASH-1400
 - o Identifies and evaluates a spectrum of accident sequences and potential releases
 - Satisfies the same dose criteria at and beyond the EPZ boundary to provide an equivalent level of protection to the health and safety of the public
 - Risk-informed, consequence based method based on a combination of quantitative evaluation and qualitative engineering judgement
- Implements state-of-the-art codes and methods established in the 40+ years since the development NUREG-0396 and WASH-1400
- Designed to be self-contained, consistent, and repeatable



Conditions of Applicability

- Applicable to only the NuScale SMR designs
 - o small modular integral pressurized light water reactors,
 - o operating modules partially immersed in water that serves as the ultimate heat sink (UHS),
 - o the UHS is retained below grade in a structure with up to 12 reactor modules per UHS,
 - o a safe shutdown earthquake with a peak ground acceleration of 0.5g, and
 - structures, systems, and components (SSCs) capable of performing their safety functions without AC electric power, DC electric power, or operator actions for at least 72 hours following a design basis event.
- The following conditions apply to the PRA used in implementing the EPZ methodology:
 - Condition 1: The PRA addresses internal and external hazards and all operating modes
 - Condition 2: The PRA is demonstrated to be technically acceptable for this purpose



Overview of the NuScale EPZ Method

- Quantitative evaluation
 - o Identify the spectrum of accidents sequences that form the basis of EPZ sizing
 - Core damage design basis source term (DBST) from final safety analysis report (FSAR) Ch 15
 - Probabilistic risk assessment (PRA) single and multi-module sequences from FSAR Ch 19
 - Other radiological releases outside of the DBST and PRA
 - Identify accident severity
 - Calculate the time-dependent source term to the environment
 - Final EPZ distance is the smallest distance at which all dose criteria are satisfied
 - Criterion a total effective dose equivalent (TEDE) dose from the DBST ≤ 1 rem mean and 5 rem 95th percentile
 - Criterion b TEDE dose from less severe accidents ≤ 1 rem mean and 5 rem 95th percentile
 - Criterion c substantial reduction in early health effects, acute whole body dose from more severe accidents ≤ 200 rem
- Qualitative evaluation
 - Evaluation of plant-level defense-in-depth against INSAG-10 and RG 1.174
 - Review and disposition of key assumptions and uncertainties in the underlying PRA







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Overview of the NuScale EPZ Method Quantitative Evaluation

PM-120945 Rev. 0



Spectrum of Accidents

- Design basis source term (DBST) from FSAR Ch 15
- Severe accidents from the site and design-specific PRA
 - o Identify non-seismic single module and multi-module sequences with core damage frequency (CDF) ≥ 1E-07 per year
 - Screening at 1E-07 captures a spectrum of accidents with similar frequencies to the EPZ basis in NUREG-0396
 - Use of CDF as the screening mechanism conservatively ignores the conditional probability of radionuclide release
 - Non-seismic sequence uncertainty against screening threshold considered consistent with NUREG-1855
 - Retain sequences with point-estimate CDF > 1E-08 and 95th percentile CDF > 1E-07
 - Ensures cliff-edge sequences are captured in the spectrum of accident sequences
- Other releases potential radionuclide releases not captured by the DBST and PRA
 - For example: spent fuel pool risks or mechanical damage to the fuel
 - $_{\circ}~$ One of the following criteria are met
 - The release meets the dose-based criteria for the appropriate accident severity
 - The consequences of the release are bounded by the DBST and screened-in PRA sequences
- Accident severity
 - Intact containment accidents are less severe
 - Containment failure or bypass accidents are more severe

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Off-site Dose Consequences

- Dose criteria provide level of protection to the public that meets or exceed the basis in NUREG-0396
 - Oriterion a total effective dose equivalent (TEDE) dose from the DBST ≤ 1 rem mean and 5 rem 95th percentile
 - Criterion b TEDE dose from less severe accidents ≤ 1 rem mean and 5 rem 95th percentile
 - Oriterion c substantial reduction in early health effects, acute whole body dose from more severe accidents ≤ 200 rem
- Modeling of dose receptors consistent with the NUREG-0396 basis
 - Stationary individual located:
 - outdoors
 - in the azimuthal direction of maximum exposure
 - at and beyond the site boundary distance
 - No sheltering, relocation, or evacuation
 - o Cloudshine, groundshine, inhalation, resuspension inhalation, and skin deposition dose pathways
 - No shielding from cloudshine, inhalation, and skin deposition
 - Natural groundshine shielding due to variations in terrain
 - 96 hour exposure for TEDE, 24 hour exposure for acute red marrow
 - Parametric evaluation of uncertainty in source term and dose calculations

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Defense-in-Depth Evaluation and Review of PRA Uncertainties

- Defense-in-depth evaluation using the guidance in INSAG-10 and RG 1.174
 - Highlight design features and SSCs available to prevent and mitigate the consequences of postulated accidents
 - Confirms the existence, functionality, and capability of features and strategies to provide confidence in the acceptably low plant risk and demonstrate protection of the health and safety of the public
- Review of PRA Uncertainties
 - Complete a review of the assumptions and sources of uncertainty in the underlying PRA to identify and address any potential impact to EPZ sizing
 - Key assumptions in the PRA
 - Model uncertainty
 - Completeness uncertainty

RG 1.174



Summary

- Topical report provides a method for determining PEP EPZs surrounding NuScale plant sites consistent with the EPZ technical basis in NUREG-0396 and WASH-1400
- Provides a level of protection to the public that meets or exceeds the NUREG-0396 EPZ basis
- Applicable to NuScale SMR designs only





Acronyms

- CDF core damage frequency
- DBST design basis source term
- EPZ emergency planning zone
- FSAR final safety analysis report
- LTR licensing topical report
- PEP plume exposure pathway
- PRA probabilistic risk assessment
- RAI request for additional information
- SMR small modular reactor
- SSC structures, systems, and components
- TEDE total effective dose equivalent
- UHS ultimate heat sink

