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NRR/NSIR Observations on NuScale's Proposed RAI Responses and Accident Dose Analysis on the Risk-Informed NuScale Emergency Planning Zone Sizing Methodology Topical Report, Revision 2

October 27, 2021

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EP Regulatory Basis

- Requirements in 10 CFR 50.47, 10 CFR Part 50 Appendix E, and 10 CFR Part 20.
- EPZ for power reactors generally 10 miles in radius.
- May be determined on a case-by-case basis for reactors with power < 250 MWt.
- Basis for 10 mile plume exposure from NUREG 0396.
- Page I-9, NUREG 0396, “design basis accidents and less severe core-melt accidents should be considered for Protective Actions.”
- EPA-400/R-17/001, Protective Actions, Table 1-1: Sheltering-in-place or evacuation of the public: 1 to 5 rem dose over four days.
- More severe core damage events compared against 200 rem.

- NOTE: Comment period for draft EP rule for SMR and NLWR and non power production facilities recently closed.

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Part 50 Applicants Using TR

The staff will write a condition of use that this TR may be used by an applicant for an operating license under 10 CFR Part 50 if:

(1) The applicant submits the PRA results and insights for staff review as part of their FSAR consistent with the Commission expectations for the use of the PRA as described in the Statement of Considerations for 10CFR Part 52 (72 FR 49387) below.

(2) The level of design detail in the PRA will be commensurate with a 10CFR Part 52 combined license (COL) application.

In the Statement of Considerations for 10 CFR Part 52, (72 FR 49387) the NRC expects that generally, the information that it needs to perform its review of an application from a PRA perspective is that information contained in the applicant's FSAR Chapter 19. The staff should issue a request for additional information (RAI) and conduct audits of the complete PRA (e.g., models, analyses, data, and codes) to obtain clarifying information as needed. The staff will document any NRC audits performed in audit reports so that they may be referenced in the staff's safety evaluation report (SER). However, neither the RAI process nor onsite audits should be used to supplement an incomplete application.

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RAI 1.05-43 QHOs

RAI 1.05-43 QHOs – A COL applicant by Commission Policy will demonstrate that the design meets the QHOs with a seismic margins analysis, so aggregating risk with seismic core damage sequences is not necessary if the risk gap of using 1E-5 external event screening criterion is removed to allow identification of a complete spectrum of accident conditions.

The resolution of RAI 1.05-43 is linked to the review and status of RAI 1.05-44 on external events screening criteria. RAI 1.05-43 will be resolved-closed when RAI 1.05-44 is resolved-closed.

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RAI 1.05-44 External Event Screening

Since NuScale verbally agreed to remove the 1E-5 screening criteria for all external events other than seismic in planning calls, the staff developed a methodology to provide feedback on the seismic risk screening threshold specific to this application (i.e., EPZ sizing) leveraging the seismic hazard information from NTTF 2.1.

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RAI 1.05-45 – PRA Uncertainty

The staff will write a condition of use that the user of the TR will provide a discussion of how the PRA key assumptions and sources of uncertainty for each hazard and mode were identified, and how their impact on the decisions using the methodology, including the numerical screening thresholds, was assessed and dispositioned consistent with NUREG 1855, Revision 1 and with the Regulatory Guide for the EP rule for SMRs and ONTs.

- Draft final RG for EP rule, Appendix A, provides an example, "if the mean frequency of a scenario is below a screening threshold, but the upper end of the frequency uncertainty range lies above that threshold, then the scenario should be considered for inclusion in the analysis."
- Draft final RG Appendix B states, "The PRA results should retain event sequences with frequencies below the "cutoff," and analysts should use them to confirm that there are no cliff edge effects and that there is adequate defense in depth."

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RAI 1.05-46 – PRA Technical Acceptability

Staff reviewed NuScale's proposed updates in the LTR, Section 2.5.1 Conditions of Applicability.

- This LTR does not stipulate that the applicant use RG 1.200 for this voluntary application. The guidance in RG 1.200 has been referenced and followed for approved LWR risk informed applications to streamline the review.

- The staff will write a condition of use for PRA acceptability:

(a) The PRA used for this TR will be developed for all modes and hazards, including seismic, using RG 1.200 at Capability Category II. Any exceptions (e.g., inability to perform walkdowns) must be identified and justified in the application.

(b) The PRA used for this TR will be peer reviewed in accordance with NEI 17-07, Rev. 2 (for ALWRs).

If the applicant decides not to use RG 1.200 and takes an exception to the TR, the PRA submitted with this application may require an in- depth review to confirm PRA technical acceptability.

Staff review of peer review findings will consider DC/COL ISG-028, "Assessing the Technical Adequacy of the Advanced Reactor Probabilistic Risk Assessment for the Design Certification Application and Combined License Application" as applicable. (ADAMS Accession number ML161130A468)

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RAI 1.05-47 and RAI 1.05-48

RAI 1.05-47 and RAI 1.05-48: The staff has no further comments on the proposed RAI responses and associated TR updates regarding:

Guidance for applicants to not parse core damage sequences into individual components for comparison against the screening thresholds

The treatment of potential releases due to non-core damage events that would necessitate protective actions consistent with the EPA PAGS.

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Accident Dose Analysis

The specific dose coefficients specified in the TR are those based on ICRP 60 dosimetry methodology to compute the TEDE criterion. The NRC does not endorse ICRP 60 for these purposes and therefore does not endorse the use of dose coefficients based on ICRP 60 dosimetry methodology to compute TEDE. The NRC staff will not accept results in terms of TEDE utilizing dose coefficients based on ICRP 60 unless requesting an exemption from the applicable regulations.

The staff will write a condition of applicability to bring awareness to utilize appropriate dose conversion factor (DCF) files to meet specific regulatory requirements. The condition will point to which MACCS DCF files to use and how to use them.

For the purposes of computing TEDE with the MACCS code, applicants should refer to the NRC memo, “Transmittal Of Deliverable For Task 1 Under Informal Assistance Request NRR-2021-018, "Verification Of MACCS Dose Conversion To Compute Total Effective Dose Equivalent"” and staff report, “Use of MACCS Dose Coefficient Files to Compute Total Effective Dose Equivalent,” which provides a review of the currently available MACCS dose coefficient files providing dose coefficients (ADAMS Accession Nos. ML21211A583 and ML21211A584, respectively).

NRC Staff's Feedback on Seismic Risk Consideration in NuScale's Risk-Informed Emergency Planning Zone Sizing Methodology Topical Report, Revision 2

October 27, 2021

Purpose of Meeting

Provide NRC staff's feedback on seismic risk consideration in NuScale EPZ methodology

Key Messages

- NRC staff evaluated seismic risk consideration in NuScale EPZ methodology using an innovative and rigorous approach developed by the NRC staff
- Approach does not alter the reactor design and operation; Only applicable for identifying spectrum of events for EPZ sizing
- Identified insights on screening seismic sequences
- Conditions on use of methodology considered necessary
  - Address parameters outside the bounds of the staff's evaluation
  - Monitoring for changes to hazard and plant consistent with 10 CFR 50.71(h)

Why Not Use 1E-6/year Annual Exceedance Frequency (AEF) Screening?

- Different context from post-Fukushima 10 CFR 50.54(f) letter
  - 10 CFR 50.54(f) letter had no impact on established EPZs
  - Need for further regulatory actions due to re-evaluated hazard at already operating plants
- Different purpose from post-Fukushima 10 CFR 50.54(f) letter
  - 1E-6/year AEF used to make decisions on need for seismic PRA
  - Licensees performing seismic PRAs did not use 1E-6/year AEF as a screening criterion; followed the PRA Standard
  - Endorsed PRA Standard only allows sequence CDF-based screening if it is a small relative contribution to seismic CDF; no AEF-based screening
  - No consideration of multi-module risk

Screening in Contemporary Seismic PRAs Used for Risk-Informed Applications

- Seismic PRAs developed in response to post-Fukushima 10 CFR 50.54(f) letter are used to support risk-informed applications
- Seismic PRAs used to support existing risk-informed applications for design and operation changes do not use AEF-based screening
  - Follow endorsed PRA Standard
  - Endorsed PRA Standard only allows sequence CDF-based screening if it is a small relative contribution to seismic CDF

Approach for Developing Feedback - In a Nutshell

Quantify "risk gap" for various candidate seismic annual exceedance frequency (AEF) screening values

Identify AEF **screening threshold** based on **acceptable spectrum** of scenarios available for EPZ sizing considering "risk gap" evaluation

Overview of Implementation of Approach

- Step 1: Collect ensemble of hazard curves representing different sites
- Step 2: Identify candidate AEF screening thresholds and corresponding spectral accelerations
- Step 3: Identify plant-level fragility and spectral ratios
- Step 4: Convolve hazard curves with plant-level fragility
- Step 5: Calculate simple average “risk gap” (risk from scenarios not considered) from AEF below those identified in Step 2
- Step 6: Identify insights on threshold based on acceptable spectrum of scenarios available for EPZ sizing considering “risk gap” evaluation

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Abbreviations

ALWRs – Advanced Light Water Reactors

COL – Combined License

DC – Design Certification

EP – Emergency Planning

EPZ – Emergency Planning Zone

MWt – Megawatt thermal

NLWRs – Non Light Water Reactors

ONT- Other Nuclear Technologies

PRA – Probabilistic Risk Assessment

QHOs – Quantitative Health Objectives

RG – Regulatory Guide

SMRs – Small Modular Reactors

TR – Topical Report