RAIO-0219-64562

February 14, 2019

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 408 (eRAI No. 9325) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 408 (eRAI No. 9325)," dated April 05, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 408 (eRAI No.9325)," dated June 04, 2018

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) supplemental response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 9325:

- 15.00.02-1

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Paul Infanger at 541-452-7351 or at pinfanger@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9325

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9325

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Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9325
Date of RAI Issue: 04/05/2018

NRC Question No.: 15.00.02-1

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Section 47 (a)(2) states, “A description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.” Likewise, 10 CFR Part 50, Appendix K, II.4 – Required Documentation, requires that, “To the extent practicable, predictions of the evaluation model, or portions thereof, shall be compared with applicable experimental information.” Additionally, GDC-10 Reactor design states the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

As stated in RG 1.203, an evaluation model (EM) is the calculational framework for evaluating the behavior of the reactor system during a postulated transient or design-basis accident. As such, the EM may include one or more computer programs, special models, and all other information needed to apply the calculational framework to a specific event, as illustrated by the following examples:

1. Procedures for treating the input and output information (particularly the code input arising from the plant geometry and the assumed plant state at transient initiation).

2. Specification of those portions of the analysis not included in the computer programs for which alternative approaches are used.

3. All other information needed to specify the calculational procedure.

The entirety of an EM ultimately determines whether the results are in compliance with applicable regulations. Therefore, the development, assessment, and review processes must consider the entire EM.

NRELAP5 code and input models used are key components of FSAR 15.0.2 "Review of Transient and Accident Analyses" results. The staff noted that NRELAP5 models that support the Chapter 15 accident analysis (including NRELAP5 analyses for FSAR Chapters 15.1.1 through 15.6.6) are built from a base model, EC-A010-1782 "NuScale NRELAP5 Module Basemodel," rev. 0, that did not address a large number of small changes in NuScale Power Module (NPM) geometry as contained in EC-A010-1507, rev 3 “Transient Model Input Parameters.” It apears that the base model, EC-A010-1782, was built from EC-A010-1507, rev 0. NRC staff understands that the NuScale engineering change notice (ECNs) are designed to account for each NRELAP5 model document modification needed as changes or errors are identified that affect that document’s inputs or results, however, it appears to NRC staff that many document changes are without ECNs. NRC staff is trying to understand (1) how the applicant plans to reconcile the changes made in the NPM design to the NRELAP5 analyses for FSAR Chapters 15.1.1 through 15.6.6 and (2) how NRC staff can determine that the analysis model results remain valid such that margins are understood and protected.

Please provide a description of all NRELAP5 analyses that support FSAR Chapters 6 and 15 and confirm that the geometry inputs used and results obtained include adequate margin per applicable requirements of GDC-10 and 10 CFR 52.47. Additionally, please provide a list of changes in NPM geometry, or other design changes, since EC-A010-1507, rev. 0 (which is bases of EC-A010-1782) to current Rev. 3 (including any later updates) so staff can better understand the design changes made.

NuScale Response:

The NRC and NuScale held a clarification call on January 23, 2019, to discuss the NRC concerns related to the subject request for additional information (RAI). In that call the NRC requested that the response be focused on the reanalysis of Chapter 15 events using NRELAP5, version 1.4. Specifically the NRC needs to understand which analyses (including RAIs) have been performed using NRELAP5, version 1.4 and the most current basemodel.

Background

The analyses that support both Chapters 6 and 15 of the NuScale Final Safety Analysis Report (FSAR) use NRELAP5 models that are all derived from a common basemodel which is periodically updated to capture any important design changes that could be relevant to system transient simulations. The basemodel is documented in NuScale Calculation EC-A010-1782, "Reactor Module NRELAP5 Model." Currently this document is at Revision 2, dated January 22, 2019.

EC-A010-1507, "Transient Model Input Parameters," is at Revision 3 and is considered the geometry calculation for the NRELAP5 basemodel. All changes in EC-A010-1507, Revision 3 are incorporated into EC-A010-1782, Revision 2. This includes the geometry changes identified in the history of the NRELAP5 basemodel discussion provided below. A brief history of the NuScale NRELAP5 Basemodel is provided below to enhance understanding of the changes to the NRELAP5 basemodel.

History of NRELAP5 Basemodel

- EC-A010-1782, "Reactor Module NRELAP5 Model," Revision 0, was released in December 2015 based on the geometry established in EC-A010-1507, Revision 0 and the nodalization and modeling options that had been confirmed by various preliminary analyses. The basemodel used NRELAP5, version 1.0.
- ECN-A010-5147, "NRELAP5 Basemodel Error Corrections," was released in February 2017 and incorporated fixes to several input and typographical errors associated with three different condition reports. This Engineering Change Notice (ECN) was primarily conforming in nature since all important errors were previously corrected in implementing analysis.
- The EC-A010-1782, Revision 1 model was released in August 2017 and included an update to the latest design inputs as defined in the geometry calculation (EC-A010-1507, Revision 3), hydraulic losses (from NuScale Calculation EC-A030-2359, "RCS Flow Form Loss Calculation," Revision 4), and NPM operating and boundary conditions (from NuScale Report ER-0000-2486, "Safety Analysis Limits Report," Revision 4) were also included. Internal reactor coolant system (RCS) components were added as passive heat structures to the model for completeness. As applicable, error corrections from ECN-A010-5147 were also incorporated. The basemodel used NRELAP5, version 1.3.
- ECN-A010-6177, "Corrections to NRELAP5 Base Model," was released in March 2018 to address an updated pitch to the diameter ratio calculation method for the steam

generator (SG) and to address a minor error related to the distribution of SG flow losses in the RCS loop.

- The EC-A010-1782, Revision 2 model was released in January 2019 and incorporated engineering changes related to the Module Protection System design changes defined in ER-0000-2486, Revision 7 and minor changes to RCS losses described in EC-A030-2359, Revision 5. ECN-A010-6177 was also incorporated along with fixes for other minor modeling errors. This revision incorporated use of NRELAP5, version 1.4 into the basemodel.

For context, ECNs are engineering change notices which provide markups to a base document between full revisions. ECNs get approved for use by the organization owning the document. When a base document is moved to a new revision, the outstanding ECNs (markups) are incorporated into the next revision.

While the NRELAP5 basemodel is kept up to date as described above, it should be noted that each particular analysis methodology requires specific modeling changes, depending on the analysis requirements. As an example, the Containment Vessel (CNV) peak pressure analysis requires the use of conservative geometric volume inputs which requires all the RCS and CNV volumes to be biased conservatively. Another example is the Loss-of-Coolant Accident (LOCA) specific Critical Heat Flux (CHF) flag that requires a minor modification of the hot assembly heat structure flag for the purposes of performing the LOCA calculations. These various method specific model changes in addition to relevant design change incorporation or basemodel error corrections are made as necessary within each analysis such that keeping the basemodel document current was not required through the development of the analyses supporting the original Design Certification Application (DCA) submittal and supporting Topical and Technical Reports.

Current Status of DCA Analyses

The following table provides the current status of DCA analyses, including which version of NRELAP5 was used, the basemodel version used and a description of the update of the analysis.

FSAR Section	NRELAP5 Version	EC-0000-1782 Revision	Comments
15.0	1.4	1	The Return to Power analysis and associated FSAR results were updated as part of the response to RAI 9487, Question 15-5.
15.1	1.3	0	Updates to the increase in heat removal events is in progress. Due to relatively large core thermal margins demonstrated in the original FSAR analyses, these updates have been given low priority as none of the model or code changes are expected to impact the limiting transient responses.
15.2	1.3	0	Updates to the heatup events are in progress, including the completion of analyses supporting FSAR sections 15.2.1-4. However, the updated results have not yet been incorporated into NuScale's DCA. Peak RCS pressure results are very similar to the original FSAR analyses and peak secondary pressure results are still showing large margins to acceptance criteria.
15.3	N/A	N/A	There are no NRELAP5 calculations supporting this section.
15.4	1.3	0	Complete updates to the reactivity events are currently in progress. NRELAP5 code version and modeling changes are not expected to influence these calculations as the limiting Minimum Critical Heat Flux Ratio (MCHFR) event progressions are slow power ascensions to the high RCS temperature and core power trip points. These analytical limits have not changed.
15.5	1.3	0	By design the NuScale Power Module (NPM) has no significant make-up system, making this a very slow and mild transient. Therefore, the update to increase in reactor coolant inventory section has been given a low priority but will be completed as part of the overall

FSAR Section	NRELAP5 Version	EC-0000-1782 Revision	Comments
			FSAR update.
15.6.2 15.6.3 15.6.4	1.3	0	The slow decrease in RCS inventory events are primarily evaluated to demonstrate radiological release limits are met. The original FSAR analyses demonstrated significant margin to acceptance criteria, because liquid inventory protection is prioritized in the NPM design due to its importance in Emergency Core Cooling System (ECCS) functionality. None of the inventory retention actuations or analytical limits have been changed. Therefore, the results of these calculations are not expected to change.
15.6.5	1.3	0	The LOCA FSAR calculation has been completed and can be made available for audit. However, the results have not yet been incorporated into the DCA.
15.6.1 & 15.6.6	1.4	1	The FSAR description of the Inadvertent Opening of an RPV [Reactor Pressure Vessel] Valve (IORV) transient was updated as part of the response to RAI 9373, Question 15.06.06-2.
6.2	1.4	1	The FSAR description of the limiting CNV pressure and temperature transients was updated as part of the response to RAI 9482, Question 06.02.01.01.A-19.
TR-0516-49422	1.4	1	Methodology supporting calculations have been updated in the LOCA licensing topical report (LTR) to address minor modeling changes to the limiting RCS pressure and temperature initial conditions as described in the response to RAI 9085, Question 15.06.05-12.

FSAR Section	NRELAP5 Version	EC-0000-1782 Revision	Comments
TR-0516-49416	1.1-3	0	The purpose of the demonstration calculations provided in section 8 of the Non-Loss-of-Coolant Accident Analysis Methodology LTR is to demonstrate the sufficiency of the spectrum of sensitivities prescribed in section 7.2 of the LTR. The code or model changes in NRELAP5 version 1.4 are not sufficiently significant to change this purpose. Therefore, these calculation results are not expected to be modified or updated.
TR-0516-49084	1.4	1	The CNV Technical Report calculation results have been updated in response to RAI 9482, Question 06.02.01.01.A-18.
TR-0916-51299	1.4	1	The Long Term Cooling Technical Report was updated in response to RAI 9516, Question 15-26.

Summary and Conclusions

EC-A010-1782, “Reactor Module NRELAP5 Model,” Revision 2, dated January 22, 2019, has incorporated all geometry changes made and utilizes NRELAP5, version 1.4 and is consistent with EC-A010-1507, “Transient Model Input Parameters,” Revision 3. Revision 1 of EC-A010-1782 also incorporated the geometry changes from EC-A010-1507 and therefore is a sufficiently current starting point for ECCS related calculations where DHRS actuation is typically not credited.

NRELAP5 source code changes from version 1.3 to version 1.4 result in very minor differences in calculation results. The basemodel changes due to the various minor NPM design changes have also, generally, had small impact on calculated margins. The more significant changes are due to modeling corrections (e.g. LOCA level calculation change and IORV modeling option error correction) and from on-going modifications to the final analysis methodologies or applied conservatisms due to RAI responses (e.g. CNV maximum noncondensable gas concentration or long term cooling boundary condition changes). These more significant changes have already been incorporated and submitted to the NRC as part of various RAI responses. The remaining analyses are not expected to significantly change as described in Table 1. NuScale will continue

update the outstanding DCA analyses which will be available for audit on or before July 31, 2019 and will be provided to the NRC as part of the FSAR, Revision 3 submittal (estimated to occur in the 3rd quarter of 2019).

Impact on DCA:

There are no impacts to the DCA as a result of this response.