October 29, 2015

MEMORANDUM FOR: Mark Tonacci, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Gregory Cranston, Senior Project Manager ***/RA/***
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Division of New Reactor Licensing
Office of New Reactors

SUBJECT: SUMMARY OF SEPTEMBER 8, 2015, OPEN AND CLOSED MEETING WITH NUSCALE POWER, LLC, TO DISCUSS PIPING AND PIPE RUPTURE HAZARDS ANALYSES FOR DESIGN CERTIFICATION

On September 8, 2015, a meeting between representatives of the U.S. Nuclear Regulatory Commission (NRC) staff and NuScale Power, LLC, (NuScale) was held at the NuScale office located at 11333 Woodglen Drive., Suite 205, Rockville, MD 20852. The first portion of this meeting was open to public and the last half hour was used to discuss related proprietary topics in a closed session. The agenda and list of meeting attendees are included in Enclosures 1 and 2, respectively. The meeting notice is available in the Agencywide Documents Access and Management System (ADAMS) via Accession No. ML15239B304. NuScale submitted its presentation slides via a September 14, 2015, letter (ADAMS Accession No. ML15260A522). The presentation slides for the public portion are available in ADAMS with Accession No. ML15260A521.

The purpose of this meeting was for NuScale personnel to update the NRC staff on their approach to conducting stress and pipe rupture hazards analyses (PRHA) for the NuScale design piping systems. The discussion during the open portion of the meeting included a description on the level of detail analysis planned for the NuScale Design Certification Application (DCA) scheduled to be submitted by December 31, 2016. The discussion included how NuScale plans to address the considerations outlined in a white paper entitled “Piping Level of Detail for Design Certification,” March 4, 2014 (ADAMS Accession No. ML14065A067). This white paper was prepared to support pre-application discussions related to the mPower™ design, but includes concepts relevant to all new designs. The focus of the discussion was on the scope of work necessary to eliminate the need to use design acceptance criteria (DAC) for piping and PRHA in the DCA. The discussion also addressed other details of the piping design including access for inservice inspection and testing.

During the public portion of the meeting, NuScale clarified the scope of piping designed to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BP&V Code), Section III (Class 1, 2, and 3), as well as additional piping designed to the ASME B31.1, "Power Piping," standard. The only Class 1 piping system is that for the reactor coolant system (RCS) and chemical and volume control system (CVCS) inside containment. There are several Class 2 piping systems inside containment: main steam (MS); feedwater (FW); the decay heat removal system (DHRS); and portions of the control rod drive mechanism (CRDM) cooling and containment flooding and drain system (CFDS) system. In addition, there are Class 3 portions of CVCS inside containment. Outside containment but within the NuScale Power module (NPM), there are lines designed to ASME BP&V Code, Section III, Class 2 and 3, as well as ASME B31.1. Outside the NPM, connected piping is designed to ASME B31.1.

NuScale then presented their approach to completing portions of the detailed piping design before DCA submittal. This approach includes completing Revision 0 design specifications for all major components. NuScale also plans to complete a preliminary Revision A stress analysis of Class 1 and 2 piping and components. In addition, NuScale plans to complete detailed stress analyses for two representative systems:

- **The Class 1, nominal pipe size (NPS) 2 RCS letdown line.** This analysis will include loads from deadweight, seismic, thermal, and fatigue (including environmentally assisted fatigue evaluation in conformance to Regulatory Guide (RG)1.207, "Guidelines for Evaluating Fatigue Analyses Incorporating the Life Reduction of Metal Components Due to the Effects of the Light-Water Reactor Environment for New Reactors," March 2007. In the public meeting (supplemented by additional detail provided in the proprietary slides), NuScale indicated that this line is representative of the four Class 1 lines, all of which are the same size and similar safety significance. This letdown line is longer than the other lines, meaning that it includes more seismic supports and longer spans between thermal anchors. Therefore, NuScale expects this analysis to be representative of all Class 1 piping with respect to loading, as well as representing the most challenging analysis case.

- **The Class 2, NPS 4 FW line.** In the public meeting (supplemented by additional detail provided in the proprietary slides), NuScale indicated that the FW line includes significant loadings because of feedwater cyclic transients. It also experiences bounding loads for all Class 2 systems with respect to the leak-before-break (LBB) analysis.

NuScale also presented its approach to PRHA, the scope for which includes the entire NPM and the spool piece, including MS and FW piping outside containment. NuScale intends to justify use of LBB analyses for the FW and MS piping inside containment. For other piping outside the LBB scope, NuScale clarified its dual strategy to address pipe ruptures in accordance with General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases," in Appendix A, "General Design Criteria," to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50. NuScale plans to conduct its PRHA following the guidance of Standard Review Plan (SRP) Section 3.6.2 and Branch Technical Positions (BTPs) 3-3 and 3-4. These analyses will also include jet impingement analysis following the guidance in Appendix A to mPower™ Design Specific Review Standard (DSRS) Section 3.6.2 (ADAMS Accession No. ML12230A013), which was recently updated and re-issued in a draft revision to SRP Section 3.6.2 (ADAMS Accession No. ML14230A035). NuScale plans to design piping, if possible, to avoid intermediate breaks based on the criteria in BTP 3-4. NuScale also plans to

design pipe whip restraints and jet shields that could be used if breaks must be postulated to meet GDC 4. In the closed portion of the meeting, NuScale provided additional proprietary detail on the preliminary design of these features. At the DCA stage, the PRHA will be based on the piping analyses described above and are expected to include potential break locations, nearby targets, and design options to mitigate the dynamic and environmental effects of breaks, where necessary.

During the closed portion of the meeting, NuScale provided additional proprietary information on the full scope of ASME BP&V Code piping systems and the status of the analysis of these systems. NuScale also showed a proprietary video of the interior of their NPM mockup to illustrate the accessibility discussed during the public portion of the meeting.

After a caucus session, the NRC staff indicated to NuScale at the close of the public meeting that the information presented orally during the public meeting appeared to be consistent with the graded approach documented in the staff's white paper on the level of detail for piping design in design certifications. This approach relies on a full system design, complete inspections, tests, analysis, and inspection criteria (ITAAC), a thorough discussion of the methodology for analysis of all piping systems, and detailed design of the most safety-significant piping systems. At the NRC staff's request, NuScale documented in the final submitted slides their justification for selecting certain lines for detailed analysis.

The details of NuScale's piping and PRHA will be subject to NRC staff review and audit to determine their compliance with regulations and conformance to NRC guidance after the submittal of the DCA. At this stage, the NRC staff considers the NuScale approach, as described in general terms at the public meeting and in accompanying slides, to be reasonable and consistent with the approach taken for another recently submitted DCA in most respects, with one main difference. NuScale's current DCA approach does not include a detailed stress analysis for the MS piping. NuScale should ensure that any preliminary piping analysis of the MS piping includes sufficient information to support its LBB evaluation and (as necessary) a PRHA. For example, detailed analysis may be necessary to assess the dynamic effects of jet impingement and blast waves resulting from postulated MS pipe ruptures.

The NRC staff also had the following observations on the summary information provided in the slides. These points can be discussed further at the next public meeting on December 9, 2015.

1. In the discussion during the public meeting, it appeared to the NRC staff that specifications and preliminary analyses for all piping within the NPM would be completed. Slide 13, however, appears to indicate that just Class 1 and 2 systems would be completed. NuScale should clarify the approach to Class 3 piping, especially to the extent that these preliminary analyses are used to confirm the appropriateness of the piping layout.

2. Similarly, NuScale should clarify the loads that will be included in the preliminary stress analyses referenced in item 1 above. In the public meeting discussion, it appeared that thermal and seismic loads (at a minimum) would be considered.

3. Slide 20 states that modal combinations are used with reference to RG 1.92, “Combining Modal Responses and Spatial Components in Seismic Response Analysis.” NuScale should specify which revision of RG 1.92 is being used. If Revision 1 (issued in 1976) is used, then the method of combining modal responses of closely spaced modes should be specified.

To summarize, NuScale’s approach presented at the September 8, 2015,meeting appears to be reasonable and consistent with the NRC staff’s expectations on a graded approach to the level of piping design detail in a DCA without the need for DAC. The NRC staff has identified several topics for discussion at an upcoming meeting as listed above—in particular, NuScale’s approach to addressing potential MS pipe ruptures if the piping analysis remains preliminary. The NRC staff will make a final safety determination after review and audit of the detailed information in the course of the DCA review.

Project No.: PROJ0769

Enclosure:
1. Meeting Agenda
2. Attendees

cc: NuScale DC Listserv

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To summarize, NuScale's approach presented at the September 8, 2015,meeting appears to be reasonable and consistent with the NRC staff's expectations on a graded approach to the level of piping design detail in a DCA without the need for DAC. The NRC staff has identified several topics for discussion at an upcoming meeting as listed above—in particular, NuScale's approach to addressing potential MS pipe ruptures if the piping analysis remains preliminary. The NRC staff will make a final safety determination after review and audit of the detailed information in the course of the DCA review.

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cc: NuScale DC Listserv

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NAME	GCranston*	JMcLellan*	TClark*	GCranston*
DATE	10/26/2015	10/23/2015	10/26/2015	10/29/2015

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Meeting Agenda

Open Meeting

1:00 p.m.-1:15 p.m. Introductions

1:15 p.m.- 2:00 p.m. Discuss: use of piping design acceptance criteria (DAC) in the design certification (DC) application; schedule of completing analyses on each ASME piping system; which piping systems are necessary to support safe shutdown; accessibility for inservice inspection; and how the piping design and stress analysis incorporates factors such as stress intensification at piping bends, thermal expansion, and seismic design/supports.

2:00 p.m..-2:55 p.m. Questions/Answers

2:55 p.m. – 3: p.m. Break

Closed Meeting

3:00 p.m. – 3:30 p.m. Discuss: proprietary issues related to piping analyses details and proprietary questions and comments associated with the Open Meeting agenda above

List of Attendees

NRC/NRO

Theresa Clark
Yueh-Li (Renee) Li
Alexander Tsirigotis
Jason Huang
Mark Tonacci
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Demetrius Murray

NuScale Power, LLC

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Steve Mirsky
Tamas Liszkai
Steve Strout
John Price
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Ed Rodriguez
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