UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 26, 2018

MEMORANDUM TO: Samuel S. Lee, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Omid Tabatabai, Senior Project Manager ***/RA/***
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: SUMMARY OF THE APRIL 4, 2018, PUBLIC MEETING WITH NUSCALE POWER, LLC, TO DISCUSS THE U.S. NUCLEAR REGULATORY COMMISSION STAFF QUESTIONS RELATED TO THE NUSCALE SMALL MODULAR REACTOR CONTAINMENT DESIGN

On April 4, 2018, representatives of the U.S. Nuclear Regulatory Commission (NRC) and NuScale Power, LLC (NuScale) held a public teleconference meeting to discuss the NRC staff's questions related to the NuScale small modular reactor containment design.

Enclosure 1 captures the summary of the discussions during the teleconference. The agenda and list of meeting attendees are included in Enclosures 2 and 3, respectively. The meeting notice for this meeting is available in the Agencywide Documents Access and Management System under Accession No. ML18081B346. The proprietary (non-public) version of the meeting summary is in ADAMS under the accession no. ML18121A462.

Docket No. 52-048

Enclosures:
1. Meeting Summary
2. Agenda
3. Attendees

CONTACT: Omid Tabatabai, NRO/DNRL
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SUBJECT: SUMMARY OF THE APRIL 4, 2018, PUBLIC MEETING WITH NUSCALE POWER, LLC, TO DISCUSS THE U.S. NUCLEAR REGULATORY COMMISSION STAFF QUESTIONS RELATED TO THE NUSCALE SMALL MODULAR REACTOR CONTAINMENT DESIGN DATED: 4/26/2018

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DATE	4/23/2018	4/23/2018	4/23/2018	4/26/2018

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U.S. NUCLEAR REGULATORY COMMISSION

SUMMARY OF THE APRIL 4, 2018, TELECONFERENCE WITH NUSCALE POWER, LLC

TO DICUSS STAFF'S QUESTIONS RELATED TO NUSCALE SMR CONTAINMENT DESIGN

The purpose of this public meeting was to discuss topics and questions related to the information contained in the design certification application submitted by NuScale Power, LLC (NuScale) NuScale regarding its small modular reactor's containment design. The U.S. Nuclear Regulatory Commission (NRC) staff and NuScale discussions included the status of staff's review of NuScale's exemption request from the requirements of Title 10 of the Code of Federal Regulations (CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors"; safety margin in the containment peak pressure calculations and analysis; Condensation; and the status of several related requests for additional information (RAI).

At the beginning of the meeting, the NRC staff provided an update on the status of their review of NuScale's request for an exemption from the requirements of 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors." The NRC staff stated that they have identified underlying challenges related to the exemption request and have issued RAIs 9147, 9164, 9216 and are evaluating NuScale responses. Furthermore, the NRC staff has just issued RAI 9474 with follow-up questions addressing: how the maximum leak rate will be demonstrated; how the containment vessel (CNV) design meets the Types B and C acceptance criteria; identification of key attributes and inspections that will be verified during containment vessel reassembly; as-left Type B testing of all CNV flanges at each refueling; and the description of an assembled CNV during factory hydrotesting.

Additionally, during the meeting the NRC staff discussed the outstanding containment issues related to the containment design margin for peak calculated containment pressure. General Design Criterion (GDC) 50, "Containment Design Basis," of Appendix A to 10 CFR Part 50 requires that the containment be designed with a sufficient margin to accommodate the pressure and temperature conditions resulting from any design basis event (DBE) without exceeding the design leakage rate. The NRC staff stated that even though the design specific review standard for Section 6.2.1.1, "Containment," suggests at least a 10-percent margin above the accepted peak calculated containment pressure following a DBE, the staff is open to considering lower margins provided the uncertainties around it are well understood.

NuScale's Chapter 6, "Engineered Safety Feactures," analyses for peak containment pressure show a margin of about 5 percent between the peak containment pressure of 951 psia predicted for the limiting DBE of inadvertent opening of a reactor recirculation valve (RRV) and the 1,000 psia containment design pressure. During the meeting, the NRC staff described several groupings of issues related to the Chapter 6 containment pressure analysis. The NRC staff has submitted several RAIs to be able to make a reasonable assurance finding that the safety analysis results demonstrate sufficient margin to the design pressure.

The first group of RAIs focuses on whether reactor pressure vessel (RPV) and containment input parameters and initial conditions are conservative enough for the nuclear power module (NPM) containment response analyses to meet the GDC 16, "Containment Design," 38, "Containment Heat Removal," and 50, "Containment Design Basis," requirements. A limiting DBE model is expected to use the most conservative NPM initial and boundary conditions that should be based on the most biased reactor operating conditions and the limiting technical specifications. This includes the RPV coolant temperatures and pressurizer pressure; and containment free volume used for the containment design basis analyses. The NRC staff needs to understand the technical basis for selection of these parameter values used in the limiting containment response analyses as well as the uncertainties around them. As containment peak pressure is a critical figure of merit and the containment design margin is rather small, the NRC staff needs to ensure that RPV input parameters, such as T-hot, T-ave, and pressurizer pressure, that are used for the containment safety analyses, are conservatively biased to bound the uncertainty of the steam generator (STG) model that is based on the SIET facility test data. The NRC staff also needs to make sure that all the uncertainties in the containment free volume, such as due to the RPV thermal expansion, are duly accounted for. The NRC staff also needs to ensure that the licensing basis analyses would be up-to-date and incorporate all the intermediate design changes. This should also include the rise of initial CNV pressure from 2 psia to 3 psia, as was concluded by RAI 8793, Question 29717 (06.02.01-2) for consistency with the involved limiting conditions for operation. The NRC staff issued RAI 9482 to have the justification that the results are valid over the applicable range of the DBE's. The NRC staff has also issued RAI 9467 requesting Tier 1 inspection, test, analysis, and aceptance criteria (ITAAC) to verify the as-built containment free volume and passive heat sink parameters vis-à-vis the ones credited to the design-basis analyses.

The second group of RAIs looks into the ability of the NRELAP5 containment model to accurately represent the actual NPM containment response. RAI 9380 was issued to assess the NRELAP5 code's ability to predict liquid water temperature stratification inside the containment vessel and its impact on containment peak pressure. If the code does not appropriately capture the thermal stratification in the liquid water accumulating inside the containment, say due to inadequate nodalization, it is likely to predict higher liquid temperatures than the actual values. Such an over prediction of the liquid temperatures would allocate a higher-than-actual enthalpy to the liquid space, and a lower-than-actual enthalpy to the vapor space, which would result in a lower-than-actual containment pressure prediction that would be non-conservative. Actually, this mismatch was indeed noted by the staff between the code predictions and the NIST-1 HP-06 test data. So, RAI 9380 was issued to look into this safety-significant issue of potential thermal stratification and its non-conservative impact on containment peak pressure prediction. The NRC staff also issued RAI 9317 which questions the significant mismatch between the code predicted pressure and NIST-1 HP-02 test data, which raises concerns about the NRELAP5 modeling of the high pressure steam condensation and other thermal-hydraulic phenomena and distortions encountered in the HP-02 test that is a separate effects test.

The NRC staff also issued RAI 8990 and is currently evaluating NuScale's response to this RAI. The NRC staff believes that the NuScale response does not bound the modeling uncertainty in peak containment pressure due to the uncertainty involved in predicting the high-pressure steam condensation on the containment wall using the {{ }} Furthermore, NuScale uses the {{ }}, and the NRC staff has more questions on how the {{ }}. Therefore, the NRC staff does not agree with the NuScale assertion that no uncertainty is required for the NuScale use of the {{ }}. The NRC staff needs reasonable assurance that uncertainties in the heat transfer correlation, or its implementation, do not adversely impact the available containment design margin, specififcally, because NuScale's design margin is only 5 percent and condensation is the key accident mitigation mechanism that also dictates the peak containment pressure and temperature. The NRC staff is planning to issue a supplemental RAI to request NuScale to bound the uncertainty around the prediction of condensation heat transfer coefficient. The NRC staff issued RAI 9494 regarding significant NIST-1 scaling distortions in the code's ability to predict peak containment pressure at various power levels. The RAI also asks NuScale to clarify the intended applicability of the loss-of-cooland accident (LOCA) and non-LOCA Topical Reports (TR) to the Containment Response Analysis Methodology (CRAM), including specification of the portions of those two TR considered applicable to the CRAM.

RAI 9357, in this group, also seeks additional information about the mass and energy release for the five DBE cases presented in the "Containment Response Analysis Methodology Technical Report." NuScale informed the NRC staff that while preparing a response to RAI 9357, an error was discovered in the model that is used to calculate containment pressure response for various cases documented in the TR. NuScale has identified a corrective action for revising the containment safety analyses that will delay the RAI 9357 response to August 1, 2018. Additionally, due to this error, NuScale won't be able to respond to the RAI 9304 as previously scheduled. RAI 9304 was submitted to NuScale requesting NuScale to update the CRAM Technical Report to include a mass and energy release table for the limiting peak pressure and temperature cases with a sufficiently resolved time step sampling for the duration of the break. The NRC staff understands that NuScale anticipates a few months before they can update their data, model, and various documentations.

During the public meeting, the NRC staff reiterated the importance of receiving NuScale's responses to the outstanding NRC staff's RAIs by August 1, 2018, in order to allow sufficient time to resolve the safety concerns in a timely manner and avoid any potential review schedule impact.

NRC staff discussed the status of RAI 8785 issues related to completeness of the LOCA break spectrum specifically if ECCS valve nozzles would be considered break locations. It was noted that the resolution is under purview of Division of Engineering (DE) so this RAI is being unresolved closed and resolution deferred to DE RAIs 9187 and 9358. Staff also mentioned that partial opening of ECCS valves could be an issue but its resolution would again be determined in DE.

NRC staff also discussed the status of RAI 8985 outstanding issues related to NRELAP5 capability to predict phenomena for spurious opening, FSAR chapter 15.6.6, of either Reactor Recirculation Valve (RRV) or Reactor Vent Valve (RVV) with the resulting loss of RCS coolant to containment. In the RAI NRC staff noted NIST tests addressed inadvertent opening of a RVV but that no similar tests were performed for RRV opening. NuScale indicated that preparations for the RRV NIST test are underway and they committed to running test by Jun 6, and having post-test RELAP assessments three months after.

U.S. NUCLEAR REGULATORY COMMISSION

SUMMARY OF THE APRIL 4, 2018, TELECONFERENCE

WITH NUSCALE POWER, LLC

MEETING AGENDA

Meeting Introductions	NRC/NuScale	1:00 – 1:10 pm
Status of U.S. Nuclear Regulatory Commission (NRC) staff Review of Appendix J exemption request	NRC	1:10 – 1:20 pm
Margin in the containment analysis - update on the status of the RRV NIST testing	NuScale	1:20 – 1:30 pm
Margin in the containment analysis - Status of the review of RAI responses concerning CNV analysis margin and the pending RAIs	NRC	1:30 – 1:45 pm
Status of staff's review of NuScale's response to RAI 8985	NRC	1:45 – 1:55 pm
Condensation heat transfer model - determining the peak containment pressure and temperature	NuScale	1:55 – 2:20 pm
Sensitivity to containment nodalization	NuScale	2:20 – 2:40 pm
Potential STG model over prediction and the impact on initial stored energy estimation	NuScale	2:40 – 3:00 pm
Public Comments (end of public portion – if a closed session is needed)	Public	3:00 – 3:10 pm
Potential thermal stratification and its impact on containment peak pressure	NuScale	3:10 – 3:25 pm
Meeting Conclusion	NRC/NuScale	3:25 – 3:30 pm

U.S. NUCLEAR REGULATORY COMMISSION

SUMMARY OF THE APRIL 4, 2018, TELECONFERENCE

WITH NUSCALE POWER, LLC

LIST OF ATTENDEES

NuScale Power, LLC

Jennie Wike
Bob Houser
Zachary Rad
Claudio Delfino
Gary Becker
Scott Harris (part time)
Gary McGee (part time)
Meghan McCloskey
Eric Coryell
Brian Wolf
Pravin Sawant
Selim Kuran
Rick Biasca (part time)
Ed Heald (part time)
Greg Myers

U.S. Nuclear Regulatory Commission Staff

Omid Tabatabai
Syed Haider
Shanlai Lu
John Monninger
Greg Cranston
Clint Ashley
Kevin Coyne
Sam Lee
Anne-Marie Grady
Nicholas McMurray
Jason Huang
Luis Betancourt
Michelle Hart
Carl Thurston
Peter Lien
Dinesh Taneja
Mohsen Khatib-Rahbar (NRC Contractor, ERI)
Alfred Krall (NRC Contractor, ERI)
Zhe Yuan (NRC Contractor, ERI)