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RAIO-178648

January 30, 2025 Docket No. 52-050

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Responses to NRC Request for Additional Information No. 033 (RAI-10298 R1) on the NuScale Standard Design Approval Application

REFERENCE: NRC Letter to NuScale, “Request for Additional Information No. 033 (RAI-10298-R1),” dated October 31, 2024

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

The enclosures to this letter contain NuScale's response to the following RAI question from NRC RAI-10298 R1:

- XPC.LTR-2

Enclosure 1 is the proprietary version of the NuScale response to NRC RAI No. 033 (RAI-10298 R1, Question XPC.LTR-2). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 1 has also been determined to contain Export Controlled Information. This information must be protected from disclosure per the requirement of 10 CFR § 810. Enclosures 2 is the nonproprietary versions of the NuScale response.

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

If you have any questions, please contact Amanda Bode at 541-452-7971 or at abode@nuscalepower.com.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 30, 2025.

Sincerely,

Mark W. Shaver

Mark W. Shaver
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Mahmoud Jardaneh, Chief New Reactor Licensing Branch, NRC
Getachew Tesfaye, Senior Project Manager, NRC

Enclosure 1: NuScale Response to NRC Request for Additional Information RAI-10298 R1, Question XPC.LTR-2, Proprietary
Enclosure 2: NuScale Response to NRC Request for Additional Information RAI-10298 R1, Question XPC.LTR-2, Nonproprietary
Enclosure 3: Affidavit of Mark W. Shaver, AF-178649

Enclosure 1:

NuScale Response to NRC Request for Additional Information RAI-10298 R1, Question XPC.LTR-2, Proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information RAI-10298 R1, Question XPC.LTR-2, Nonproprietary

Response to Request for Additional Information
Docket: 052000050

RAI No.: 10298
Date of RAI Issue: 10/31/2024

NRC Question No.: XPC.LTR-2

Issue

The TR-124587 methodology is missing needed information relative to the methodology assumptions for RCS and ESB mixing in the following areas:

a) The methodology does not provide an adequate basis for model validation vs test data {{

}}$^{2(a),(c)}$ Riser holes have an impact on thermal hydraulic conditions, for example but not limited to, initial conditions, natural circulation and RCS response; these impacts and any others need to be addressed.

b) Validation basis information/evaluations for the assumed condensate flow rate into the boron dissolver basket and containment mixing tubes is missing. There is no justification provided for the assumed fraction of the available containment wall area above each condensate rail that is used in determining the condensate collector flow rate, considering the non-uniformity of the containment wall shell as well as the other structures in the containment that influence condensation and condensate flow.

c) The methodology is missing the basis information/evaluations that validates the {{

}}$^{2(a),(c)}$ Additionally, the methodology is missing the basis information that validates the transport assumptions of fluid from one mixing volume to the next, {{

}}$^{2(a),(c)}$ (The gradients and flow patterns/behavior in the volumes have not been validated.)

Information Requested

a) Provide justification via sensitivity studies demonstrating that NRELAP5 can adequately calculate the actual expected NPM response with respect to the integrated topical report model. The total integral response of the LTR model (from beginning of the event until the end of the long-term cooling phase) to various design basis events and conditions should be validated considering that the tests did not include flow holes and no other activities have been performed to quantify the impact on the total integral response and conditions of the RCS during design basis events. The potential impact on the RCS response and conditions for the integrated model on the figures of merit calculated by the topical report model and downstream activities should be shown analytically as described below:

Provide sensitivity analyses and evaluations of the impact of riser holes on the integral effects tests responses used for Evaluation Model validation for the XPC LTR. The various impacts of riser holes on the integral test validation response should be captured in the impacts on the integrated NRELAP5 evaluation model results for XPC analyses.

Provide sensitivities and evaluations for the impact of riser holes on the total integral response of the LTR models (XPC LTR model) to various design basis events and conditions that show that the test validation response to riser holes is captured. The impact on the RCS response and conditions for the integrated model on the figures of merit calculated by the XPC LTR model should be shown analytically.

Revise the LTR to include the above information.

b) Provide the validation basis information/evaluations for the assumed condensate flow rate into the boron dissolver basket and containment mixing tubes that justifies the assumed fraction of the available containment wall area above each condensate rail that is used in determining the condensate collector flow rate, considering the non-uniformity of the containment wall shell as well as the other structures in the containment that influence condensation and condensate flow. The potential impact on the NPM response due to the uncertainty added by the condensate flow rate assumptions on the figures of merit should be quantified to support justifications and provided in the response.

Specifically, (1) Provide the methodology description that specifically states how the credited fraction of the available containment wall area is determined; state specifically how the geometry is used and how influences on condensation and condensate flow rate are considered. (2) Provide the methodology description for how the credited minimum CNV surface area interacts with the channels that are directed toward the boron dissolver baskets. One of the channels enters the basket but is not used for diluting the boron. Describe how the minimum CNV surface area is distributed to the channels. (3) Provide the methodology description for how the dissolver condensate collection capacity is determined and a description of how the dissolver condensate collection capacity is used. (4) Provide the methodology description which states how the ESB mixing tube containment wall area is determined and how the methodology accounts for major obstructions. (5) Provide the methodology description for how the mixing tube condensate collection capacity is determined or a description of how the dissolver condensate collection capacity is used.

Provide the requested information through revisions to the XPC LTR or SDAA.

c) To justify the transport and mixing assumptions in the XPC LTR, provide an analytical basis and evaluations that validate {{

}}2(a),(c) The gradients and flow patterns/behavior in the volumes should be validated analytically (such as through computational fluid dynamics). The analytical basis needs to account for the density difference between borated and pure water, because not accounting for the boron density leads to a result that is less conservative than a best estimate calculation. The density difference impact should be part of the validation methodology and uncertainties due to density and temperature should be quantified and the impacts on the figures of merit identified.

Revise the XPC LTR to include the requested information.

NuScale Response:

NuScale Response to Part a

NuScale previously provided information in the responses to audit questions A-NonLOCA.LTR-1, A-XPC.LTR-2, and A-XPC.LTR-27 that demonstrate the following:

- {{

  }}2(a),(c)

- {{

}}$^{2(a),(c)}$

Based on this information previously provided in response to audit questions, NuScale concluded that no further studies of riser holes were warranted. However, in response to this and other related requests for additional information (RAI) specifically requesting additional studies, NuScale's response to RAI question NonLOCA.LTR-1 provides the results of multiple sensitivity studies focused on the impact of riser holes on the short-term transient response. These sensitivity studies include {{

}}$^{2(a),(c)}$ The sensitivity studies include a study of the NIST-2 LOCA Run 1 assessment described in Section 4.2.3.5 of TR-124587-P, Revision 0, "Extended Passive Cooling and Reactivity Control Methodology". NIST-2 LOCA Run 1 is a chemical and volume control system (CVCS) discharge line break similar to NIST-1 HP-06, and is run to 80,000 seconds which captures the long-term cooling response.
{{

}}$^{2(a),(c)}$

The results of the sensitivity study for the Run 1 test assessment demonstrates the following:

- {{

}}$^{2(a),(c)}$

A markup of TR-124587-P is included with this response to describe the sensitivity study of the NIST-2 LOCA Run 1 assessment.

NuScale Response to Part b

The information requested in Part b of this RAI question is provided in NuScale's response to Part b of audit item A-XPC.LTR-2 and NuScale recommends docketing that audit response.

NuScale Response to Part c

Executive Summary

A boron dilution analysis is part of the methodology described in TR-124587-P. The analysis calculates the boron concentration in the reactor vessel for 72 hours after design basis events and compares this concentration to the calculated boron concentration required for subcriticality. Conservatisms are applied to both boron concentration calculations, including the following:

- highest-worth control rod assembly remains out of the core
- operator action is not credited
- {{

}}$^{2(a),(c)}$

{{

}}$^{2(a),(c)}$

{{ }}$^{2(a),(c)}$

To quantify the conservatism of assuming the {{ }}$^{2(a),(c)}$, NuScale performed a detailed, transient, three-dimensional computational fluid dynamics (CFD) evaluation. The CFD analysis simulates a {{ }}$^{2(a),(c)}$ Consistent with qualitative engineering judgment, the quantitative CFD analysis confirms that {{ }}$^{2(a),(c)}$

The existing CFD analysis results confirm that {{ }}$^{2(a),(c)}$ This conservative assumption results in approximately 500 percent reduction in margin in the limiting case. Additional CFD analysis to further quantify differences in {{ }}$^{2(a),(c)}$

Boron Dilution Analysis Overview

The boron dilution analysis calculates the boron concentration in the reactor core after design basis events and compares this concentration to the boron concentration required to maintain subcriticality (referred to as the critical boron concentration). If the calculated boron concentration in the reactor core remains greater than the critical boron concentration during the 72-hour analysis period, then the reactor remains subcritical.

Boron Transport

The analysis {{

}}$^{2(a),(c)}$

Figure 1: Volumetric Regions used in the Boron Dilution Analysis

{{

}}$^{2(a),(c)}$

The boron dilution analysis models {{

}}$^{2(a),(c)}$

In order to characterize conservatisms of the boron transport method, the following discussion provides a description of the expected boron transport response to the spectrum of design basis events. A scenario postulating {{

}}$^{2(a),(c)}$ when the event progression is considered in total.

During normal operation, boron in the reactor coolant is well-mixed inside the RPV. Operators decrease the reactor coolant boron concentration over the operating cycle to maintain the core reactivity balance. With respect to boron transport, the initial progression of a transient or accident can vary depending on the initiating event:

- Non-loss-of-coolant accident (non-LOCA) events:
    - A non-LOCA event without mass release into containment results in reactor trip and DHRS operation.
    - Failure of a pipe connected to the reactor component cooling water (RCCW) system, or a main steam line break or feedwater line break inside containment discharges unborated water into the lower region of containment until containment isolation is actuated. The reactor trips and DHRS operation removes decay heat.
- LOCA events:
    - Failure of a CVCS pipe connected to the pressurizer spray or high point vent line piping inside containment discharges vapor from the RCS into containment. The protection system actuates a reactor trip, containment isolation, and DHRS actuation.
    - Failure of a CVCS pipe connected to the injection line or discharge line inside containment discharges liquid and vapor from the RCS into containment. The protection system actuates a reactor trip, containment isolation, and DHRS actuation.

For the purpose of boron dilution analysis, conditions near end of cycle with low RCS boron concentration are limiting for demonstration of subcritciality. Therefore the progression of the non-LOCA event with mass release into containment or the LOCA events are similar, except that ECCS actuation timing varies. For events that discharge mass into the CNV, before ECCS actuates, vapor condenses on the CNV wall. For the non-LOCA events, natural circulation of liquid in the lower CNV begins due to the radial temperature gradient between the hot RPV wall and the cold CNV wall , and vapor is generated near the hot RPV wall.

As vapor condenses on the CNV wall, the ECCS supplemental boron (ESB) rails collect some of the condensate and direct it into the ESB boron baskets or mixing tubes. Condensate flow over boron oxide in the baskets dissolves boron and the borated liquid flows into the CNV annulus space. The mixing tubes discharge unborated condensate liquid into the bottom of the CNV to displace borated liquid. {{

}}$^{2(a),(c)}$

In the US460 design, ECCS actuates {{

}}$^{2(a),(c)}$ The reactor vent valves (RVVs) discharge vapor and entrained liquid from the pressurizer into the upper CNV; vapor condensation rates increase on the upper CNV wall. The two RRVs discharge liquid and two-phase fluid, directed downwards, into the CNV. Therefore, realistically, downward RRV liquid discharge from two points 180 degrees apart is expected to mix with borated liquid in the lower CNV as the liquid level in the CNV increases above the RPV flange and covers the RRVs to establish long-term recirculation.

During long-term ECCS operation, liquid recirculates from the RRVs into the downcomer, then into the core region. Decay and residual heat transfer generate vapor in the hot core and riser region. Vapor condenses on the outside of the steam generator tubes above the downcomer (energy is transferred to the reactor pool via the DHRS), and vapor is vented through the RVVs into the CNV. Vapor inside the CNV condenses on the CNV walls; some of the condensate is collected by the ESB rails and is directed into the boron baskets or mixing tubes.

Therefore, with respect to boron transport and liquid in the CNV, before ECCS actuation, {{ }}$^{2(a),(c)}$ due to the following:

- {{

}}$^{2(a),(c)}$

Then, ECCS actuation, with RCS discharge downward through the two RRVs, is expected to mix the RCS coolant with borated liquid in the CNV. As the module transitions from ECCS blowdown to recirculation, natural circulation flow develops in the CNV annulus between the hot RPV wall and the cold CNV wall.

Figure 2: Reactor Pressure Vessel Flange Constriction and Relative Elevation of Reactor Recirculation Valves

{{

}}$^{2(a),(c),ECI}$

As shown in Figure 1, the boron dilution method {{

}}$^{2(a),(c)}$

- The RRVs, attached to the RPV, point downward in the containment annular space, while {{

  }}$^{2(a),(c)}$ When borated liquid transports out of the core and riser region into the downcomer through the lower riser holes, {{

  }}$^{2(a),(c)}$ that compares to the critical boron concentration.

{{

}}$^{2(a),(c)}$

Critical Boron Concentration

The critical boron concentration in the analysis is primarily dependent on the moderator temperature coefficient, along with the temperature change of the moderator (i.e. cooling), and the buildup and decay of isotopes in the core after shutdown. Calculations with low initial boron concentrations in the RCS corresponding with end of cycle conditions are limiting due to the large negative moderator temperature coefficient present at the end of cycle.

Biases and Conservatisms

Table 1 shows biases and conservatisms applied to the boron dilution analysis with a summary of the impact on the analysis. The biases and conservatisms include prescriptive deterministic assumptions required for regulatory approval, such as the assumption that the highest worth control rod remains withdrawn from the core for at least 72 hours, as well as analysis-specific conservatisms such as assuming {{

}}$^{2(a),(c)}$

Increasing core boron concentration or decreasing critical boron concentration increases margin, and vice-versa.

Table 1: Biases and Conservatisms in the Boron Dilution Analysis

Bias/Conservatism	**Impact on Analysis**
Highest-worth control rod remains out of the core	Reduces negative reactivity insertion from control rods, resulting in a higher critical boron concentration
No operator action credited	Additional boron addition to the reactor core from the CVCS is not accounted for in the analysis.
{{ }}$^{2(a),(c)}$	{{ }}$^{2(a),(c)}$
{{ }}$^{2(a),(c)}$	Results in less transport of boron to the core in limiting cases
{{ }}$^{2(a),(c)}$	{{ }}$^{2(a),(c)}$ Lower moderator temperature results in more reactivity insertion to the core due to negative moderator temperature feedback, resulting in a higher critical boron concentration.
{{ }}$^{2(a),(c)}$	{{ }}$^{2(a),(c)}$
{{ }}$^{2(a),(c)}$	{{ }}$^{2(a),(c)}$; resulting in slower transport of boron to the core
{{ }}$^{2(a),(c)}$	{{ }}$^{2(a),(c)}$ moderator temperature results in more reactivity insertion to the core due to negative moderator temperature feedback, resulting in a higher critical boron concentration.
Supplemental boron mass in ESB dissolvers biased low	Reduces boron addition by the ESB and results in lower core boron concentrations
{{ }}$^{2(a),(c)}$	Reduces boron addition by the ESB and results in lower core boron concentrations

Analysis Results for Reactor Component Cooling Water Event

With the biases and conservatisms in Table 1 applied, the current limiting case (i.e., lowest margin between the core boron concentration and critical boron concentration) is a break in piping connected to the RCCW system. {{

}}$^{2(a),(c)}$ After ECCS actuation, this supplemental boron in the lower CNV is transported to the upper CNV by mass displacement through the mixing tube, into the RCS downcomer region, and ultimately to the RCS core and riser.

Graphical results of the boron dilution analysis of this event are shown in Figure 3 of this response.

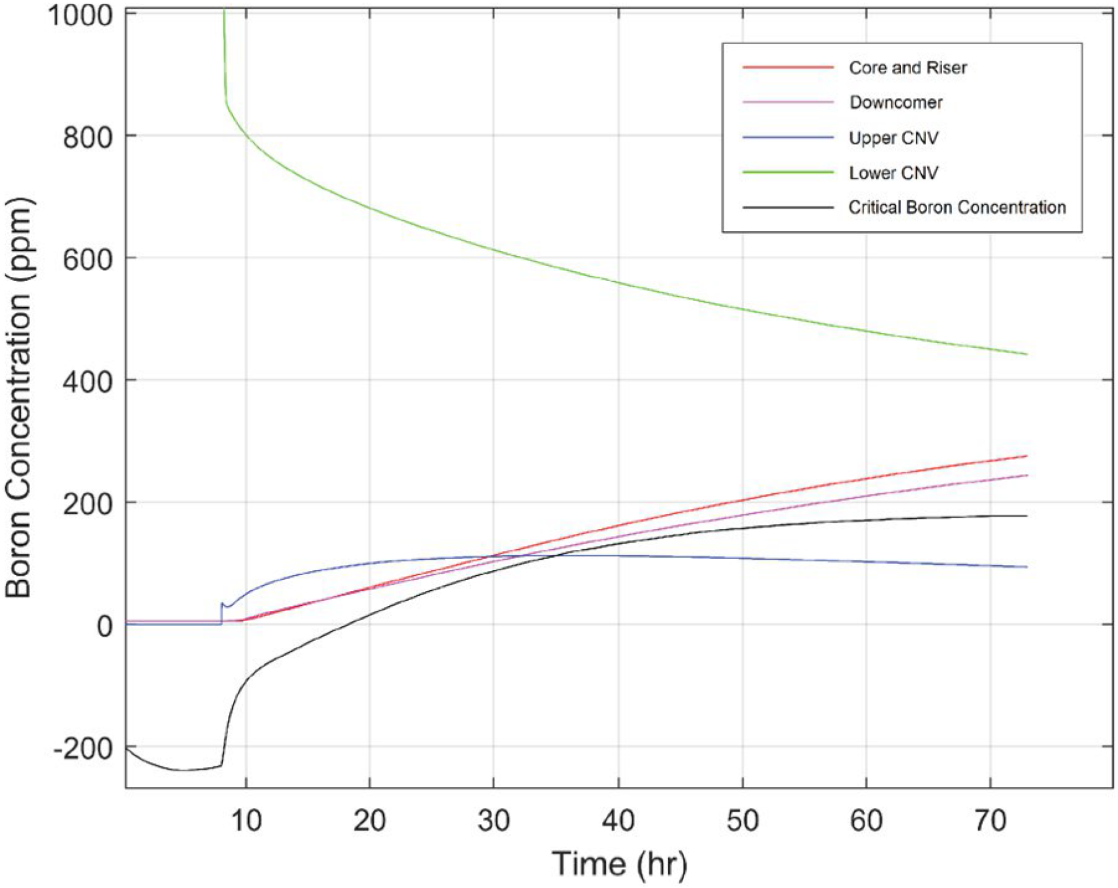
- The green curve shows the lower CNV region has a high boron concentration before ECCS actuation at 8 hours, due to the RCCW dissolving the ESB into liquid and collecting below the RPV flange. After ECCS actuation at 8 hours, RPV blowdown adds dilute water (5 ppm) to the CNV, rapidly reducing the lower CNV concentration from above 1000 ppm to around 850 ppm. As the ESB directs condensate into the mixing tubes, some borated liquid in the the lower CNV region is displaced and transported to the upper CNV region, as shown by the downward trend in the green plot.
- The blue curve shows the upper CNV region boron concentration increasing due to displaced borated liquid from the lower CNV region after ECCS actuation. Boron in the upper CNV is then transported through the RRVs to the RCS downcomer, which feeds the core and riser. {{ }}$^{2(a),(c)}$, the upper region concentration is initially more than 500 ppm less than the lower region, and remains approximately 300 ppm less than the lower region at the end of 72 hours.
- The pink curve shows the RCS downcomer increasing due to boron transport from the upper CNV. {{

  }}$^{2(a),(c)}$
- The red curve shows the core and riser concentration increasing due to boron transport from the RCS downcomer.

- The black curve shows the critical boron concentration, which is influenced by changes in core reactivity due to RCS cooldown and changes in core isotopes (e.g., xenon). During DHRS cooling, the critical boron concentration changes relatively slowly as the moderator temperature cools and core isotopes evolve after shutdown. At 8 hours, ECCS actuation rapidly decreases the RPV pressure and temperature and the critical boron concentration increases rapidly as a result. By 10 hours the rate of change of pressures and temperatures decreases and the slow increase in boron concentration again relates primarily to the evolution of core isotopes (e.g. xenon decay).

The lower riser hole flow rates assumed in the boron transport analysis are biased low, which increases the difference between the core/riser and downcomer regions. The analysis results meet the acceptance criterion for subcriticality because the boron concentration in the RPV, both the core and riser volume (red curve) and the downcomer volume (pink curve), remain above the critical boron concentration (black curve). Higher riser hole flow rates would result in less difference between the core/riser and downcomer region concentrations.

Figure 3: Boron Dilution Analysis Results – Reactor Component Cooling Water Line Break ({{ }}$^{2(a),(c)}$)



Demonstration of Conservatism

Quantification of conservatism in the boron transport analysis focuses on the assumed {{

}}$^{2(a),(c)}$

{{

}}$^{2(a),(c)}$, as demonstrated below.

To quantify the conservatism associated with assumed {{

}}$^{2(a),(c)}$

As shown in Figure 3, the conservatisms in the boron dilution analysis are such that the {{

}}$^{2(a),(c)}$, which results in less boron transported to the core (lowering the red curve). {{

}}$^{2(a),(c)}$, which would result in more boron transported to the core (raising the red curve) and improve margin to the critical boron concentration.

The assumed {{ }}$^{2(a),(c)}$ results in reduced boron concentration in the core and riser . This impact is illustrated by comparing {{ }}$^{2(a),(c)}$ (Figure 3) to {{ }}$^{2(a),(c)}$ (Figure 4). {{ }}$^{2(a),(c)}$ The {{ }}$^{2(a),(c)}$ always shows at least {{ }}$^{2(a),(c)}$ of margin between the core concentration and the critical boron concentration, compared to the approximately 25 ppm minimum margin in the {{ }}$^{2(a),(c)}$ case. This difference represents a 500 percent increase in margin to the critical boron concentration.

{{ }}$^{2(a),(c)}$ for the high point vent line outside containment analysis in final safety analysis report Figure 15.0-7, Boron Transport Analysis Concentrations - High Point Vent Line Break Case. For the high point vent line break outside containment, there is no mass release into the CNV until ECCS actuation at 8 hours and the ESB boron oxide {{ }}$^{2(a),(c)}$. In this event progression the core and riser concentration is approximately 200 ppm higher than the critical boron concentration after the critical boron concentration is greater than 0 ppm.

This significant (500 percent) increase in margin to the acceptance criterion is reasonably expected to outweigh the impacts of {{ }}$^{2(a),(c)}$. If the CFD analysis is {{ }}$^{2(a),(c)}$ when the additional biases and conservatisms described in Table 1 are considered.

Figure 4: Boron Dilution Analysis Results – {{

}}$^{2(a),(c)}$

{{

}}$^{2(a),(c)}$

To further demonstrate the conservatism in the boron transport methodology and quantify the conservatism with respect to CNV mixing times, a sensitivity evaluation was performed. {{

}}$^{2(a),(c)}$

{{

}}$^{2(a),(c)}$

Figure 5 of this response shows the results of the existing boron transport methodology for an RCCW line break. Figure 6 of this response shows the results of the modified boron transport calculation for the same transient. Figure 6 shows the {{

}}$^{2(a),(c)}$

Figure 5: Boron Transport Analysis Sensitivity - Existing Methodology

{{

}}$^{2(a),(c)}$

Figure 6: Boron Transport Analysis Sensitivity - Modified Calculation

{{

}}$^{2(a),(c)}$

Conclusion

Together, the CFD analysis, the comparison between {{ }}$^{2(a),(c)}$ cases, and the sensitivity evaluation demonstrate significant conservatism in the boron dilution analysis. This conservatism, combined with other conservatisms described in Table 1, are reasonably expected to outweigh impacts from justified simplifications in the boron dilution method, and assumptions in the CFD analysis {{ }}$^{2(a),(c)}$. However, to ensure conservatism is maintained in the analysis to account for potential impacts from the assumptions in the CFD analysis {{ }}$^{2(a),(c)}$, a markup to TR-124587-P adds a condition on the use of the boron transport methodology. The condition restricts the use of the dilution methodology to cases with at least 25 ppm of minimum margin between the core region boron concentration and the critical boron concentration; or, for cases with less than 25 ppm minimum margin, analysis demonstrates the methodology is conservative with respect to delayed onset of mixing between CNV volumes, due to liquid density differences in the volumes. {{ }}$^{2(a),(c)}$

Impact on Topical Report:

Topical Report TR-124587, Extended Passive Cooling and Reactivity Control Methodology, has been revised as described in the response above and as shown in the markup provided in this response.

RAI XPC.LTR-2

The NIST-2 assessments of Run 1 {{

}}$^{2(a),(c)}$

4.2.3.6 Assessment Results: Inadvertent RVV Opening Case (Run 3)

Run 3 of the NIST-2 LOCA test series represents a steam space break that utilizes the RVV line (reminiscent of the NIST-1 HP-09 case). Table 4-6 provides the sequence of events for Run 3. Overall, the sequence timings between the data and the simulation match well. {{

}}$^{2(a),(c)}$

Table 4-6 LOCA Run 3 Sequence of Events

{{

}}$^{2(a),(b),(c),ECI}$

Figure 4-50 and Figure 4-51 compare the predicted RPV and CNV system pressures with the data for the full test duration and the long-term cooling portion of the transient (i.e., after 20,000 seconds), respectively. During the long-term cooling period (time greater than 20,000 seconds), the simulation shows reasonable-to-excellent agreement with the measured data.

4.4.3.34 3D Flow, Boron Distribution and Mixing in the CNV

{{

Audit Question A-XPC.LTR-2
RAI XPC.LTR-2

}}2(a),(c) Therefore, it is concluded that the boron transport method conservatively accounts for effects of 3D flow, boron distribution and mixing in the CNV, with appropriate methods specified for boron dilution analyses and boron precipitation analyses.

Table 4-17 Top-Down Assessment for Extended ECCS Phenomena (Continued)

{{

RAI XPC.LTR-2

}}$^{2(a),(c)}$

{{

RAI XPC.LTR-2

}}2(a),(c)

6.2.3 Boron Transport Mechanisms

The following mechanisms transport boron between mixing volumes. {{

}}2(a),(c)

representative results demonstrate that the collapsed liquid level remains above the TAF, showing the DHRS and ECCS provide adequate core cooling for an extended period. In addition, boron precipitation is evaluated and representative results show boron precipitation does not occur for the conditions evaluated for extended passive cooling, thereby demonstrating the core remains in a coolable geometry. Potential criticality during cooldown was evaluated and representative results indicate acceptable reactivity margin is available for design basis cooldown scenarios.

The XPC EM is applicable to NPM plant designs if the following criteria are met:

1. The plant design is as described generally in Section 3.2.
2. The plant design has the specific features or requirements identified in Table 3-3.
3. The conclusions of supporting evaluations identified in Section 3.2.3 are met.
4. The range of conditions for extended ECCS cooling are within the range identified in Table 4-11.
5. The range of conditions for extended DHRS cooling are within the ranges identified in Table 4-8 and Table 4-9.
6. Any changes to the LOCA EM or non-LOCA EM applicability ranges identified in Table 4-11, Table 4-8, or Table 4-9 are identified for impact on the XPC EM.

Audit Question A-15.0.5-1

7. Boron oxide pellet diameter is less than or equal to 0.25 in, or applicability of the slow-biased boron dissolution method is specifically justified and approved.

RAI XPC.LTR-2

8. The results of the boron dilution transport methodology in Section 6.0 demonstrate at least 25 ppm of minimum margin between the core-region boron concentration and the critical boron concentration; or, for cases with less than 25 ppm minimum margin, analysis demonstrates the methodology is conservative with respect to delayed onset of mixing between CNV volumes, due to liquid density differences in the volumes. Analysis of time to onset of mixing between CNV control volumes must address initially stratified effects of fluid temperature and boron concentration.

After application of the methodology is approved for a plant design, cycle-specific evaluations are required to confirm the analysis of record remains applicable. Comprehensive identification of required cycle-specific evaluations is outside scope of this report.

Enclosure 3:

Affidavit of Mark W. Shaver, AF-178649

NuScale Power, LLC

AFFIDAVIT of Mark W. Shaver

I, Mark W. Shaver, state as follows:

(1) I am the Director of Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.

(2) I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:

   (a) The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.

   (b) The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.

   (c) Use by a competitor of the information requested to be withheld would reduce the competitor’s expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

   (d) The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.

   (e) The information requested to be withheld consists of patentable ideas.

(3) Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale’s competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the response by which NuScale develops its NuScale Power, LLC Response to NRC Request for Additional Information (RAI No. 10298 R1, Question XPC.LTR-2) on the NuScale Standard Design Approval Application.

NuScale has performed significant research and evaluation to develop a basis for this response and has invested significant resources, including the expenditure of a considerable sum of money.

The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

If the information were disclosed to the public, NuScale’s competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale’s intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

(4) The information sought to be withheld is in the enclosed response to NRC Request for Additional Information RAI No. 10298 R1, Question XPC.LTR-2. The enclosure contains the designation “Proprietary” at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, “{{ }}” in the document.

(5) The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).

(6) Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:

(a) The information sought to be withheld is owned and has been held in confidence by NuScale.

(b) The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.

(c) The information is being transmitted to and received by the NRC in confidence.

(d) No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.

(e) Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 30, 2025.

Mark W. Shaver

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