NuScaleTRRaisPEm Resource

From:	Cranston, Gregory
Sent:	Monday, June 18, 2018 2:01 PM
To:	Request for Additional Information
Cc:	Lee, Samuel; Karas, Rebecca; Skarda, Raymond; Bavol, Bruce; Chowdhury, Prosanta; NuScaleTRRaisPEm Resource
Subject:	Request for Additional Information Letter No. 9444 (eRAI No. 9444) Topical Report Thermal Hydraulic, 15.9, SRSB R1
Attachments:	Request for Additional Information No. 9444 (eRAI No. 9444).pdf

Reissued to correct subject line for previous email to show that the RAI No and the eRAI No are both 9444. The attached RAI is correct.

Attached please find NRC staff's request for additional information (RAI) concerning review of the NuScale Topical Report.

The NRC Staff recognizes that NuScale has preliminarily identified that the response to one or more questions in this RAI is likely to require greater than 60 days. NuScale is expected to provide a schedule for the RAI response by email within 14 days.

If you have any questions, please contact me.

Thank you.

Hearing Identifier: NuScale_SMR_DC_TR_Public
Email Number: 96

Mail Envelope Properties (BN3PR09MB03554477792FFFCAF571CB5790710)

Subject: Request for Additional Information Letter No. 9444 (eRAI No. 9444) Topical Report Thermal Hydraulic, 15.9, SRSB R1
Sent Date: 6/18/2018 2:00:58 PM
Received Date: 6/18/2018 2:01:02 PM
From: Cranston, Gregory

Created By: Gregory.Cranston@nrc.gov

Recipients:
"Lee, Samuel" <Samuel.Lee@nrc.gov>
Tracking Status: None
"Karas, Rebecca" <Rebecca.Karas@nrc.gov>
Tracking Status: None
"Skarda, Raymond" <Raymond.Skarda@nrc.gov>
Tracking Status: None
"Bavol, Bruce" <Bruce.Bavol@nrc.gov>
Tracking Status: None
"Chowdhury, Prosanta" <Prosanta.Chowdhury@nrc.gov>
Tracking Status: None
"NuScaleTRRaisPEm Resource" <NuScaleTRRaisPEm.Resource@nrc.gov>
Tracking Status: None
"Request for Additional Information" <RAI@nuscalepower.com>
Tracking Status: None

Post Office: BN3PR09MB0355.namprd09.prod.outlook.com

Files	**Size**	**Date & Time**
MESSAGE	608	6/18/2018 2:01:02 PM
Request for Additional Information No. 9444 (eRAI No. 9444).pdf		62552

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information No. 9444 (eRAI No. 9444)

Issue Date: 06/16/2018
Application Title: NuScale Topical Report
Operating Company: NuScale
Docket No. PROJ0769
Review Section: 15.09 - A.DSRS NuScale Thermal Hydraulic Stability
Application Section: 15.9

QUESTIONS

15.09-8

Title 10 of the Code of the Federal Regulations (CFR), Part 50, Appendix A, General Design Criterion (GDC) 10 – Reactor Design, states that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences (AOOs). GDC 12, suppression of reactor power oscillations requires that the reactor core and associated coolant, control, and protections systems be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed. GDC 26 states that two independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive mean for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including AOOs, and with appropriate margin for malfunctions such as stuck rods, SAFDLs are not exceeded.

The staff reviewed the response to the original RAI (RAI 8803) and found that the response was insufficient for the staff to reach a conclusion regarding whatever stability or thermal margins may be available during the limiting AOO. The response stated that, "analysis of a post-trip return to power during emergency core cooling system (ECCS) cooling conditions where a vapor volume exists atop the riser and cold leg is outside the scope of the stability Topical Report and the PIM code," however this does not address a return to power condition without or prior to ECCS actuation, nor does it confirm that under ECCS actuation the reactor would be subcritical. Further, the scope of the stability Topical Report and Section 15.9 in the FSAR indicate that the stability Topical Report provides the methodology and analyses supporting GDC 12.

In the Stability TR, an analysis is provided of a limiting depressurization AOO, but this analysis does not consider the possibility of recriticality and return to power as pressure decreases. Either with or without ECCS actuation, the stability solution (as described by the Topical Report) must be effective in preventing oscillations that exceed SAFDLs in order to be in compliance with GDC 12.

Therefore in order to make an affirmative finding with regard to the above regulatory requirements important to safety, the NRC staff requests the following supplemental information be updated in the Stability TR and/or FSAR sections 15.0.6 or 15.9, as appropriate:

(I) Neither the response to RAI 8803, nor the return to power analysis in FSAR 15.0.6, address the possibility of flow/power instabilities, which may occur under the DHRS cooldown scenario. FSAR Section 15.0.6 goes on to state that subcriticality is achieved when the ECCS is actuated (for decay heat above 100 kW). For the staff to reach a reasonable assurance finding regarding GDCs 10 and 12 the staff is requesting the following:

1) To address RCS stability during a DHRS cooldown the staff is requesting an evaluation of stability prior to ECCS actuation at 24 hours using an appropriate code(s) or method(s) capable of determining the following parameters:

- a description of the incidence and prevalence of subcooling boiling including any local effects due to the stuck rod
- minimum riser subcooling margin (or maximum riser void fraction)
- the decay ratio (DR), or if DR > 1.0, a calculation showing the limit cycle flow oscillation
- oscillation frequency

2) If a decay ratio greater than 1.0 exists, demonstrate that the proposed stability solution is effective in precluding instabilities that could challenge the SAFDLs.

3) To address the reactor system behavior during a DHRS cooldown, and that subcriticality occurs upon ECCS actuation such that instabilities are not a CHF concern; demonstrate the reactivity parameters (e.g., density reactivity coefficient) used in the FSAR section 15.0.6 return to power analyses are conservatively determined using a qualified code such as SIMULATE and cover the range of expected RCS conditions.

4) If flow oscillations occur during the DHRS cooldown scenario, evaluate MCHFR at time of minimum flow using a qualified systems code such as NRELAP5. Compute final MCHFR values using a subchannel code, for example VIPRE-01, or justify why a subchannel analysis is not necessary.

(II) Neither the response to RAI 8803, nor the return to power analysis in FSAR 15.0.6, address the possibility of flow/power instabilities, which may occur during a slow depressurization transient following reactor trip. The Stability TR provides an analysis of a limiting depressurization scenario to demonstrate the function of the module protection system to trip the reactor, however, the analysis does not consider the possibility of a return to power if one control rod remains stuck out of the reactor core. If the depressurization AOO would result in ECCS actuation, the staff requests an analysis that addresses both the pre- and post-ECCS actuation phases of the transient. For the staff to reach a reasonable assurance finding regarding GDCs 10 and 12 the staff is requesting the following:

1) To address the initial conditions of the reactor system prior to the initiation of the limiting AOO and to address the potential for a return to power as the RCS depressurizes, the staff requests an analysis for the most conservative combination of nuclear design parameters such as reactivity feedback parameters, critical boron concentration, burnup state, initial primary side temperature, power distribution, etc. that shows the margin to recriticality with the worst rod stuck out as a function of system pressure.

2) For points identified in (1) that return to power, or may return to power given consideration of uncertainties, perform an analysis using appropriate, qualified methods that provides:

- the hot assembly peaking factor
- core temperature rise
- a description of the incidence and prevalence of subcooling boiling
- core flow rate
- hot assembly flow rate
- minimum riser subcooling margin (or maximum riser void fraction)
- the DR, or if DR > 1.0, a calculation showing the limit cycle flow oscillation
- oscillation frequency

3) If flow oscillations occur, calculate the MCHFR using a qualified method. It is acceptable to provide this result assuming steady-state conditions with a flow equal to the minimum flow observed during the oscillation.

4) If MCHFR violates applicable AOO related limits, describe how the stability solution is effective in precluding instabilities that could challenge the SAFDLs.