NuScaleTRRaisPEm Resource

From:	Cranston, Gregory
Sent:	Monday, September 11, 2017 12:36 PM
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Cc:	NuScaleTRRaisPEm Resource; Lee, Samuel; Haider, Syed; Karas, Rebecca; Schmidt, Jeffrey; Chowdhury, Prosanta; Bavol, Bruce
Subject:	Request for Additional Information Letter No. 9080 (eRAI No. 9080) Topical Report Thermal Hydraulic Design
Attachments:	Request for Additional Information No. 9080 (eRAI No. 9080).pdf

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

Please submit your response within 60 days of the date of this RAI to the NRC Document Control Desk. 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.

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Request for Additional Information No. 9080 (eRAI No. 9080)

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Application Title: NuScale Topical Report
Operating Company: NuScale
Docket No. PROJ0769
Review Section: 04.04 - Thermal and Hydraulic Design
Application Section: 4.4

QUESTIONS

04.04-12

NSAM Application & NSP2 CHF Correlation Applicability Ranges

General Design Criterion (GDC) 10, "Reactor design" of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 requires 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). NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition", Section 4.4, "Thermal and Hydraulic Design," stipulates the staff's review process for thermal and hydraulic design applications. One of the acceptance criteria specified in SRP Section 4.4 for the evaluation of fuel design limits is to ensure that the hot fuel rod in the core does not experience departure from nucleate boiling (DNB) during normal operation or AOOs. GDC 10 is relevant to the DNB as it is used to establish safety-related margins for the fuel and cladding integrity. To ensure compliance with GDC 10, the staff needs to confirm that the thermal-hydraulic design of the core and the reactor coolant system is accomplished using acceptable analytical methods; is equivalent to or is a justified extrapolation from proven designs; provides adequate margins of safety from conditions that would lead to fuel damage during normal reactor operation and AOOs; and is not susceptible to thermal-hydraulic instability.

Section 2.2 of Volume 5 of the VIPRE-01 manual identifies a spectrum of VIPRE code limitations. Condition No. 3 from the VIPRE-01 MOD-02 safety evaluation report (SER) stipulates that each user should ensure that the code is not being used in violation of these limitations. Section 2.2 of the VIPRE-01 manual states that VIPRE should not be applied to situations that entail conditions such as low-flow boil-off, annular flow, phase separation involving a sharp liquid/vapor interface, or countercurrent flow. Furthermore, Section 2.2 of Volume 5 of the VIPRE-01 manual also identifies another VIPRE-01 limitation arising due to the omission of several cross-coupling terms from the lateral momentum equation that leads the code to predict the flow field accurately only when wall friction is significant and lateral flow resistance is fairly large compared to axial flow resistance.

Table 3-1 of the topical report (TR) shows the parameter ranges used to demonstrate the applicability of the NuScale subchannel analysis methodology (NSAM) with the example NSP2 critical heat flux (CHF) correlation. The example NuScale normal/off-normal parameter ranges are 1,700–2,200 psia for pressure, 0.1-0.5 Mlbm/hr-ft2 for local coolant mass flux, and < 20% for the local equilibrium quality. The staff is concerned that all example ranges chosen in the NSAM TR to demonstrate VIPRE application are narrower than the corresponding NSP2 CHF correlation applicability ranges of 300–2,300 psia for pressure, 0.11-0.70 Mlbm/hr-ft2 for local coolant mass flux, and < 95% for the local equilibrium quality, as reported in Table 7-2 of the NSP2 CHF correlation TR. For instance, the example local equilibrium quality used in the NSAM TR is up to only 20%, while the NSP2 CHF correlation limit for local equilibrium quality is up to 95%. Likewise, the example lower limit of pressure used in the NSAM TR is 1,700 psia, which is significantly higher than the 300 psia lower limit of the NSP2 CHF correlation. The staff needs to evaluate the applicability of NSAM for the safety of the NuScale design over the full range of the NSP2 CHF correlation application, as VIPRE-01 was used for the development of NSP2 CHF correlation and the VIPRE-01 based NSAM is expected to be approved for the entire NSP2 CHF correlation range. The applicant is requested to justify the applicability of VIPRE-01 over the spectrum of transients and two-phase phenomena involving the complete NSP2 CHF correlation range, and update the NSAM TR accordingly. The applicant needs to demonstrate that the NuScale application of VIPRE would not violate the code limitations identified by Section 2.2 of Volume 5 of the VIPRE-01 manual, throughout the NSP2 CHF correlation's full range. Submittal of the additional information is required for making the safety finding regarding the overall applicability of the NSAM to the NuScale core safety design.