NuScaleTRRaisPEm Resource

From:	Chowdhury, Prosanta
Sent:	Tuesday, May 8, 2018 5:37 PM
To:	Request for Additional Information
Cc:	Lee, Samuel; Cranston, Gregory; Karas, Rebecca; Burja, Alexandra; Franovich, Rani; NuScaleTRRaisPEm Resource
Subject:	Request for Additional Information Letter No. 9513 (eRAI No. 9513) Topical Report, Non-LOCA Analysis Methodology, 15.00.02, SRSB
Attachments:	Request for Additional Information No. 9513 (eRAI No. 9513).pdf

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.

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Office of New Reactors
U.S. Nuclear Regulatory Commission
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Request for Additional Information No. 9513 (eRAI No. 9513)

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Operating Company: NuScale
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Application Section: TR-0516-49416-P, Non-LOCA Analysis Methodology

QUESTIONS

15.00.02-14

General Design Criterion (GDC) 10, "Reactor design," 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). In addition, GDC 15, "Reactor coolant system design," requires that the reactor coolant system (RCS) and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary (RCPB) are not exceeded during any condition of normal operation, including AOOs.

Topical report (TR) TR-0516-49416-P, "Non-Loss-of-Coolant Accident [Non-LOCA] Analysis Methodology," supports the conclusions relative to GDC 10 and 15 in the NuScale Final Safety Analysis Report (FSAR). Regulatory Guide (RG) 1.203, "Transient and Accident Analysis Methods," describes a process that the staff finds acceptable for developing and assessing evaluation models. Section 1.1.4 of RG 1.203 describes the identification and ranking of key phenomena and processes and states: "An optimum analysis reduces candidate phenomena to a manageable set by identifying and ranking the phenomena with respect to their influence on figures of merit. Each phase of the transient scenario and system components are separately investigated." The outcome of this process is a phenomena identification and ranking table (PIRT), which should be used to determine the requirements for physical model development, scalability, validation, and sensitivity studies.

TR Sections 5.1.4.28, **[[ ]]**, and 5.1.4.32, **[[ ]]**, state that these phenomena are highly ranked during **[[ ]]** , which the staff notes is a figure of merit during Phase 3 (stable natural circulation) as well. To provide a consistent understanding of the presented PIRT high-ranked phenomena, explain why these phenomena are not highly ranked during Phase 3, and update TR-0516-49416-P as appropriate.

15.00.02-15

Title 10 of the *Code of Federal Regulations* (10 CFR) 50.43(e) states that applications that use simplified, inherent, passive, or other innovative means to accomplish their safety functions will be approved only if sufficient data exist on the safety features of the design to assess the analytical tools used for safety analyses over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences. The NuScale design credits a passive decay heat removal system (DHRS) that operates on the principle of natural circulation to provide core cooling following transients and accidents. The DHRS is therefore one of the design features relied upon to meet GDC 10 and GDC 15.

TR-0516-49416-P, Section 5.3.1, describes the KAIST experiments, which formed part of the validation of the NuScale NRELAP5 DHRS model. TR-0516-49416-P concludes that the assessment shows reasonable to excellent agreement between calculated NRELAP5 and KAIST measured data. While the staff observes the agreement is generally good, the staff is of the opinion that the assessed quantities (condensed liquid flows, heat transfer coefficients, and inner wall temperatures) do not provide adequate assurance of qualification of the NRELAP5 DHRS model to predict **[[ ]],** so additional information is therefore necessary to support a finding on GDC 10 and 15. Please provide additional justification of the qualification of the NRELAP5 DHRS model for this purpose, such as a plot of measured versus calculated total heat transfer as a function of pressure **[[ ]]** . Update TR-0516-49416-P as appropriate.

15.00.02-16

GDC 10 requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs. In addition, GDC 15 requires that the RCS and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the RCPB are not exceeded during any condition of normal operation, including AOOs.

TR-0516-49416-P supports the conclusions relative to GDC 10 and 15 in the NuScale FSAR. TR Section 7.1.6.1, "Initial Conditions," provides a general description of how the various initial conditions may be biased to maximize the consequences of a transient or accident with respect to the various acceptance criteria. The staff notes that this section of the TR does not include the steam generator (SG) heat transfer bias, despite the fact that it is applied in most of the event-specific methodologies in TR Section 7.2 and in many sections of the FSAR. To provide a basis for the biases that are applied to SG heat transfer, and to support the staff’s GDC 10 and 15 finding, add a discussion of the SG heat transfer bias to TR Section 7.1.6.1.

15.00.02-17

GDC 10 requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs. In addition, GDC 15 requires that the RCS and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the RCPB are not exceeded during any condition of normal operation, including AOOs.

TR-0516-49416-P supports the conclusions relative to GDC 10 and 15 in the NuScale FSAR. TR Section 7.2, "Event Specific Methodology," provides representative results of sensitivity studies and states that such studies are performed to identify plant conditions that result in bounding transient analyses. It is the staff's understanding based on audit discussions with the applicant that these sensitivity studies are examples only and should be conducted for each new licensing basis calculation to establish bounding analyses. However, TR Section 1.2, "Scope," is unclear about the purpose of these sensitivity studies. While the TR states that representative analysis results are provided to illustrate results from application of the EM, the TR also states that the scope of the evaluation model includes the general and event-specific analysis methodologies of the EM in Section 7.0 of the TR (which is where the representative sensitivity study results reside). Because the scope of the evaluation model should be clearly defined such that the staff is able to support its GDC 10 and 15 findings, and because the purpose of the representative sensitivity studies may be unclear to a user of the methodology, please clarify the intent of the representative sensitivity studies. Update TR-0516-49416-P to clearly reflect this intent.

15.00.02-18

GDC 15 requires that the RCS and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the RCPB are not exceeded during any condition of normal operation, including AOOs. TR-0516-49416-P supports the conclusions relative to GDC 15 in the NuScale FSAR.

The staff notes that several initial conditions, biases, and conservatisms tables in Section 7.2 of the TR state that the bounding **[[ ]]**

The staff notes that a **[[ ]]** may not lead to limiting primary and secondary pressure responses due to reduced heat transfer capability in the primary and reduced heat transfer to the secondary. Furthermore, it may be possible that a transient could produce a primary overpressure condition such that **[[ ]]** . Provide further justification for the **[[ ]]** for most transients, and update TR-0516-49416-P as appropriate.

15.00.02-19

GDC 10 requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs. TR-0516-49416-P supports the conclusions relative to GDC 10 in the NuScale FSAR.

The initial conditions, biases, and conservatisms tables in TR Section 7 discuss moderator temperature coefficient, but do not discuss the Doppler temperature coefficient (DTC) as part of the event specific methodologies. The staff notes that the value chosen for DTC affects the reactivity feedback during the transient, which may increase or decrease the severity of the transient and the margin required by GDC 10. Therefore, DTC is an assumption that should be included in consideration of each event-specific methodology. Please update the event-specific methodologies to address the bounding direction for DTC.

15.00.02-20

GDC 10 requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs. GDC 13, "Instrumentation and control," requires the provision of instrumentation to monitor variables and systems over their anticipated ranges of normal operation, including the effects of AOOs, and of appropriate controls to maintain listed variables and systems within prescribed operating ranges. TR-0516-49416-P supports the conclusions relative to GDC 10 and 13 in the NuScale FSAR.

TR Sections 7.2.13, "Uncontrolled Control Rod Assembly Bank Withdrawal from Subcritical or Low Power Startup Conditions," and 7.2.14, "Uncontrolled Control Rod Assembly Bank Withdrawal at Power," state that low power startup conditions exist until the reactor power reaches **[[ ]]** . In addition, TR Section 8.3.1 of the same title assumes an initial core power of 15 percent rated thermal power. However, FSAR Tier 2, Section 15.4.1.3.2, "Input Parameters and Initial Conditions," for the uncontrolled control rod assembly bank withdrawal from subcritical or low power startup conditions, states that the maximum initial power considered in the analysis is 25 percent, as the high power trip is set at 25 percent of full power for startup conditions. To ensure that future analyses encompass the appropriate operating ranges, address the apparent discrepancy in the scope of low power conditions, and update TR-0516-49416-P as appropriate.

15.00.02-21

GDC 10 requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs. GDC 15 requires that the RCS and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the RCPB are not exceeded during any condition of normal operation, including AOOs. TR-0516-49416-P supports the conclusions relative to GDC 10 and 15 the NuScale FSAR. The information in TR-0516-49416-P needs to be accurate and consistent so the staff is able to make a reasonable assurance finding.

The staff noted that TR-0516-49416-P contains the following apparent typographical errors that affect technical meaning or details:

- Word(s) seem to be missing from a sentence in the last paragraph of TR Page 29, which states, "After DHRS is actuated, the in the DHRS flows into the SG."
- Section 5.1.4.29, **[[ ]]** , states that the primary pressure is one of the FOMs [figures of merit] in Phase 3. However, Section 5.1.3 of the TR states that primary pressure is only a FOM in Phases 1 and 2.
- Figures 5-30 and 5-31 appear to be identical despite claiming to show mid and upper temperatures, respectively. The same is true for and Figures 5-36 and 5-37.
- It appears the title of Section 5.3.5.2, "5.3.5.2 Helical Coil Steam Generator Modeling **[[ ]]** is incorrect, as the section discusses modeling at **[[ ]]** .
- It appears that the numbering of components, junctions, etc. on the nodalization diagram in Figure 6-2 is incorrect based on comparison to the NRELAP5 basemodel described in EC-A010-1782, "NuScale NRELAP5 Module Basemodel."

Please address the above items by either (1) updating TR-0516-49416-P to correct them or (2) justifying why the information is accurate.