NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Saturday, August 19, 2017 7:25 AM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Jackson, Diane; Grady, Anne-Marie; Tabatabai, Omid
Subject: RE: Request for Additional Information No. 188, RAI 9022 (6.2.5)
Attachments: Request for Additional Information No. 188 (eRAI No. 9022).pdf

Attached please find NRC staff's request for additional information concerning review of the NuScale Design Certification Application.

Please submit your technically correct and complete 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.

Gregory Cranston, Senior Project Manager
Licensing Branch 1 (NuScale)
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
301-415-0546

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Created By: Gregory.Cranston@nrc.gov

Recipients:
"NuScaleDCRaisPEm Resource" <NuScaleDCRaisPEm.Resource@nrc.gov>
Tracking Status: None
"Lee, Samuel" <Samuel.Lee@nrc.gov>
Tracking Status: None
"Chowdhury, Prosanta" <Prosanta.Chowdhury@nrc.gov>
Tracking Status: None
"Jackson, Diane" <Diane.Jackson@nrc.gov>
Tracking Status: None
"Grady, Anne-Marie" <Anne-Marie.Grady@nrc.gov>
Tracking Status: None
"Tabatabai, Omid" <Omid.Tabatabai-Yazdi@nrc.gov>
Tracking Status: None
"RAI@nuscalepower.com" <RAI@nuscalepower.com>
Tracking Status: None

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Request for Additional Information No. 188 (eRAI No. 9022)

Issue Date: 08/19/2017
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 06.02.05 - Combustible Gas Control in Containment
Application Section: Part 7

QUESTIONS

06.02.05-4

NuScale has requested an exemption from the combustible gas control requirements of 10 CFR 50.44(c)(2), which states that:

All containments must have an inerted atmosphere, or must limit hydrogen concentrations in containment during and following an accident that releases an equivalent amount of hydrogen as would be generated from a 100 percent fuel clad-coolant reaction, uniformly distributed, to less than 10 percent (by volume) and maintain containment structural integrity and appropriate accident mitigating features.

10 CFR 52.47(a)(12) requires a design certification applicant to include an analysis and description of the equipment and systems for combustible gas control as required by 10 CFR 50.44.

NuScale Design Certification Application (DCA), FSAR, Tier 2, Section 6.2.5, “Combustible Gas Control in the Containment Vessel,” discusses the potential for hydrogen and oxygen accumulation in the containment vessel (CNV) following a postulated severe accident. NuScale states “Uncovering the reactor core can result in the production of a significant amount of hydrogen due to high temperature cladding-fuel interaction with additional amounts of hydrogen and oxygen produced from radiolytic decomposition of the reactor coolant that accumulate within the CNV.”

NuScale DCA, FSAR further states that details of the evaluation of the effective control of combustible gases can be found in NuScale document TR-0716-50424, Revision 0, “Combustible Gas Control”. In TR-0716-50424, potential combustion sequences for combustible gas concentrations within the CNV were analyzed based on postulated scenarios. The beyond design basis events relevant to combustible gas control include events involving multiple emergency core cooling system (ECCS) actuation failures, including loss-od-coolant accidents, spurious valve openings, and a loss of DC power.

The NuScale PRA identifies accident sequences that result in core damage. The set of severe accident sequences with potential for hydrogen combustion selected by NuScale for evaluation are identified in DCA, FSAR Tier 2, Table 19.2-2, “Core Damage Simulations for Severe Accident Evaluation”. Staff requests that NuScale describe the scenario selection criteria, such as significant contributors to core damage frequency and Severe Accident Phenomena Identification and Ranking Table. Staff requests that NuScale identify in the FSAR Section 19.2.3 which scenarios were selected to be evaluated. Provide details of each scenario evaluation and identify the respective calculation reports..

06.02.05-5

NuScale has requested an exemption from the combustible gas control requirements of 10 CFR 50.44(c)(2), which states that:

All containments must have an inerted atmosphere, or must limit hydrogen concentrations in containment during and following an accident that releases an equivalent amount of hydrogen as would be generated from a 100 percent fuel clad-coolant reaction, uniformly distributed, to less than 10 percent (by volume) and maintain containment structural integrity and appropriate accident mitigating features.

10 CFR 52.47(a)(12) requires a design certification applicant to include an analysis and description of the equipment and systems for combustible gas control as required by 10 CFR 50.44.

10 CFR 50.12(a)(1) states that, *in part,* the Commission may grant exemptions from the requirements of the regulations od 10 Part 50, which are "Authorized by law, will not present an undue risk to the public health and safety."

NUREG-0800, Section 19.0, Design-Specific PRA (Procedures Specific to Integral Pressurized Water Reactors) states the following:

> *For small, modular integral pressurized water reactor designs, the staff reviews the results and description of the applicant's risk assessment for a single reactor module; and, if the applicant is seeking approval of an application for a plant containing multiple modules, the staff reviews the applicant's assessment of risk from accidents that could affect multiple modules to ensure appropriate treatment of important insights related to multi-module design and operation.*
>
> *The staff will verify that the applicant has:*
>
> *i. Used a systematic process to identify accident sequences, including significant human errors, that lead to multiple module core damages or large releases and described them in the application*
>
> *ii. Selected alternative features, operational strategies, and design options to prevent these sequences from occurring and demonstrated that these accident sequences are not significant contributors to risk. These operational strategies should also provide reasonable assurance that there is sufficient ability to mitigate multiple core damages accidents.*

NuScale identified severe accident simulations with potential for hydrogen combustion in FSAR Table 19.2-2 and described in FSAR Section 19.2.3.2. NuScale concluded that two of the seven scenarios, LCU-03T and LCU-01T should not be considered because the CNV was no longer intact. However, these are two cases for which CNV has been bypassed by the CVCS/RCS fluid leaks out, uncovering the core resulting in generation of hydrogen. Hydrogen leaks out of the CNV into the reactor bay which contains oxygen. NuScale ER-P060-4750

states that MELCOR predicts hydrogen combustion in the reactor bay. This potential for hydrogen combustion in the reactor bay needs to be explicitly addressed by NuScale. Therefore, NuScale should evaluate severe accidents LCU-03T-01 and LCU-01T-01, looking at potential hydrogen combustion not only within the CNV, but also in the reactor bay, and in the Reactor Building (RXB).

Staff requests that NuScale evaluate two sensitivity cases for TRN-08T-00, for the effects of hydrogen generation and combustion. The two sensitivity cases requested, both involving a Loss of DC Power with incomplete ECCS and no other mitigating systems, are designated TRN-08T-03 and TRN-08T-04 and are evaluated, predicting, but without quantifying, hydrogen generation, in ER-P060-7075, rev. 0. They are being requested as an example of Loss of DC Power cases with mitigating system failures – RRVs closed, RVVS open. Loss of DC Power scenarios are significant contributors to CDF for which hydrogen generation is expected due to core damage. Staff requests that NuScale provide analysis results for these two sensitivity cases. Staff also requests that these transients be included the FSAR Table 19.2-2.

06.02.05-6

NuScale has requested an exemption from the combustible gas control requirements of 10 CFR 50.44(c)(2), which states that:

All containments must have an inerted atmosphere, or must limit hydrogen concentrations in containment during and following an accident that releases an equivalent amount of hydrogen as would be generated from a 100 percent fuel clad-coolant reaction, uniformly distributed, to less than 10 percent (by volume) and maintain containment structural integrity and appropriate accident mitigating features.

10 CFR 52.47(a)(12) requires a design certification applicant to include an analysis and description of the equipment and systems for combustible gas control as required by 10 CFR 50.44.

In accordance with 10 CFR 52.47(a)(12), staff requests NuScale provide graphical results for all scenarios listed in FSAR Table 19.2-2 and for all CNV nodes, for oxygen concentration vs time, similar to FSAR Figure 19.2-10. Also, provide for all scenarios the molar fractions of steam, oxygen, hydrogen and nitrogen for all CNV nodes. An example of this information is shown in Figure 6-9, “Molar Fractions in CNV Upper Head,” of NuScale document ER-P060-4749, Revision 0**,** “LCC-05T: Charging Line Break Inside Containment with no Mitigation from a PRA Level 2 Perspective.”,