NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Friday, October 13, 2017 8:26 AM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Jackson, Diane; Travis, Boyce; Tabatabai, Omid
Subject: Request for Additional Information No. 250 RAI No. 9191 (6.2.5)
Attachments: Request for Additional Information No. 250 (eRAI No. 9191).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.

If you have any questions, please contact me.

Thank you.

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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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Request for Additional Information No. 250 (eRAI No. 9191)

Issue Date: 10/13/2017
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: 6.2.5

QUESTIONS

06.02.05-7

10 CFR Part 50.44, “Combustible gas control for nuclear power reactors” subpart (c), “Requirements for Future Water-Cooled Reactor Applicants and Licensees,” requires in part that all equipment required to establish safe shutdown and ensure containment function must have the capability to withstand a hydrogen burn and detonation resulting from an amount of hydrogen up to and including that generated following a fuel clad-coolant reaction involving 100 percent of the fuel cladding, unless such events can be shown to be unlikely to occur. The equipment must retain its function during and after exposure to the conditions resulting from the hydrogen burn during design-basis and significant beyond design basis accidents.

Equipment must be demonstrated to survive environmental conditions including but not limited to temperature and pressure resulting from a hydrogen burn. Although the temperature effects of combustion are explored in Section 3.3.5.6 of the combustible gas control technical report (TR-0716-50424), no provisions or discussion related to the effect of short duration temperature pulses for equipment other than steel exist. The equipment required to function includes both the steel containment and the containment penetrations, which vary in material composition. Additionally, the calculation performed by NuScale examines the effect of temperature increases due to hydrogen combustion events at only a very high level. Preliminary calculations performed by the staff indicate that mixtures closer to stoichiometric than those examined by NuScale in the TR can produce highly detonable conditions capable of producing a very short term temperature spike. The current equipment qualification envelope defined by NuScale is either a combustion temperature increase of 75 F (as defined in FSAR Tier 2 Section 19.2.3.3.8) or 300 F (as defined in Section 3.3.5.6 of the TR), and both are stated to remain within the bounds of the containment design parameters. Accordingly, the staff requests that NuScale provide a justification or additional discussion in the TR for equipment survivability in the event of a hydrogen combustion (up to a potential detonation) due to temperature effects for components required to maintain containment integrity, including penetrations, and to reconcile the existing equipment survivability limits for temperature in the FSAR/TR.

06.02.05-8

10 CFR Part 50.44, “Combustible gas control for nuclear power reactors” subpart (c), “Requirements for Future Water-Cooled Reactor Applicants and Licensees,” requires in part that all equipment required to establish safe shutdown and ensure containment function must have the capability to withstand a hydrogen burn and detonation resulting from an amount of hydrogen up to and including that generated following a fuel clad-coolant reaction involving 100 percent of the fuel cladding, unless such events can be shown to be unlikely to occur. The equipment must retain its function during and after exposure to the conditions resulting from the hydrogen burn during design-basis and significant beyond design basis accidents.

The calculated deflagration-to-detonation transition (DDT) pressure in the combustible gas control technical report (TR-0716-50424) is based on a calculated base pressure assuming the entire containment free volume is available. In the event of a severe accident of the nature examined in the TR, containment is unlikely to have no water in it, which would confine the available volume and therefore increase the base containment pressure. Staff recognizes that the water that leaves the reactor will allow for gas and vapor space within the reactor vessel, but based on initial scoping studies performed by the staff there does not appear to be a proportional relationship between the water in the vessel and the additional vapor space in the reactor vessel on the resulting calcuated pressure. Staff requests that NuScale justify why the base pressure calculated as an input using an empty containment vessel is representative of expected conditions in containment, rather than partially filled with condensed water.

06.02.05-9

10 CFR 50.44(c) requires that applicants for design certification applications demonstrate that equipment required to maintain safe shutdown and containment structural integrity remain capable of performing its function following the burning of hydrogen, and that a structural analysis be performed that demonstrates containment structural integrity following an accident that releases hydrogen generated from a 100 percent fuel clad-coolant reaction and subsequent hydrogen burn.

In TR-0716-50424, NuScale states the scope of the TR is limited to the first 72 hours because accumulation of combustible gases beyond 72 hours can be managed by licensee implementation of severe accident management guidelines. This is a reasonable summary of the NRC position with respect to combustible gas control, but that view is in the context that for traditional reactor designs, long term hydrogen concentrations are generally no worse than those considered early in the accident (as stated in FR Vol 68, No. 179, pertaining to 50.44 rulemaking). For NuScale, the inventory of combustible gases increases in a near-linear fashion as the transient progresses, instead of being largely dependent on the hydrogen release from the fuel clad-coolant reaction. From that perspective, staff requests that NuScale provide a justification why the implementation of mitigating actions after 72 hours will not result in a combustible gas inventory more severe than that analyzed during the first 72 hours.