NuScaleDCRaisPEm Resource

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Sent:	Friday, January 26, 2018 7:59 AM
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Cc:	NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Lupold, Timothy; Li, Yueh-Li; Tabatabai, Omid
Subject:	Request for Additional Information No. 340 RAI No. 9358 (3.6.2)
Attachments:	Request for Additional Information No. 340 (eRAI No. 9358).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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301-415-0546

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Request for Additional Information No. 340 (eRAI No. 9358)

Issue Date: 01/26/2018
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 03.06.02 - Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping
Application Section: 3.6.2

QUESTIONS

03.06.02-17

In response to RAI 9187, Question 03.06.02-16, NuScale stated that the configuration of the RVVs and RRVs had changed from a welded connection to a bolted connection.

In that response, NuScale also referred to its response to RAI 8776, Question 15.06.06-5, to support NuScale's position that high energy line breaks do not need to be postulated at the RVV and RRV connections to the RPV. Specifically, NuScale referred to Section III of the ASME BPV Code which defines "piping system" as "an assembly of piping, piping supports, components, and, if applicable, components supports". Further, NuScale stated that while a piping system may include non-piping components such as a valve, a piping system must at least include piping. Moreover, NuScale stated that in the NuScale design, there is no piping between the Reactor Pressure Vessel (RPV) nozzles and Reactor Vent Valves (RVVs)/Reactor Recirculation Valves (RRVs), but rather only two non-piping components welded together. Therefore, NuScale's position is that high energy line breaks do not need to be postulated at the RVV and RRV connections to the RPV.

The NRC staff disagreed with the above NuScale's interpretation of the piping system as defined in the ASME Code. The NRC staff's interpretation is that a piping system is a system that includes any of the following, piping, piping supports, components, or components supports. This NRC staff's interpretation is consistent with the definition and scope of vessel and pipe as described by the ASME Companion Guide. As described in RAI 9187, Question 03.06.02-16, Companion Guide to the ASME Boiler and Pressure Vessel Code states that Paragraph U-1(a)(2) of ASME Section VIII-1 scope addresses pressure vessels that are defined as containers for the containment of pressure, internal or external and if the primary function of the pressure container is to transfer fluid from one point in the system to another, then the component should be considered as piping. Further, Paragraph 21.3.1.2 of the Companion Guide states that the vessel boundary ends at the face of the flange for bolted connections to piping, other pressure vessels, and mechanical equipment.

Accordingly, the NRC staff considers the boundary of the vessel to be at the [bolted flange connections between the RVV and RRV and the vessel]. Therefore, the staff's position is that RVV and RRV should be considered as part of the piping system and is the extremity of the affected piping system. As stated in BTP 3-4 Section 2A(iii) that breaks should be postulated at the terminal end of each piping run. Bolting the RVVs and RRVs to a flanged connect to the reactor vessel would be a terminal end connection.

For the NuScale RVV and RRV design, the NRC staff's key concern is that this bolted flange connection to the reactor vessel must not fail catastrophically, causing a loss-of-coolant accident. Operating experience from current reactors demonstrates that degradation and failure do occur at bolted connections in nuclear power plants. Electric Power Research Institute (EPRI) NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants,"

dated April 1988, discusses various causes of bolting degradations and failures. The contributing factors to these incidents include stress corrosion cracking, boric acid corrosion, flow-induced vibration, improper torque/preload, and steam cutting. NUREG-1339, "resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," dated June 1990, discusses resolution of issues from this EPRI study. Specifically, it discusses NRC's evaluation of and exceptions to EPRI NP-5769. Further, Generic Letter (GL) 91-17, "Bolting Degradation or Failure in Nuclear Power Plants," provides information on the resolution of GSI 29.

Per the response to RAI No. 8785, Question 15.06.05-1 and based on our previous interactions with NuScale, the staff understands that NuScale is not assuming a break at this location. There is precedent for not postulating breaks in certain locations where additional design and operational criteria provide assurance that this approach is acceptable. GDC 4 explicitly allows exclusion of certain pipe ruptures when "the probability of fluid system piping rupture is extremely low"-the basis used for "leak-before-break" as described in SRP Section 3.6.3, "Leak-Before-Break Procedures." The specific guidelines included in SRP 3.6.3, are a deterministic fracture-mechanics-based approach. They are applicable for pipes only and cannot be directly applied to a bolted flange connection. However, the concept of demonstrating that leakage will be detected in time to ensure that the probability of gross failure is extremely low should be the same.

In addition, Section 2A(ii) of BTP 3-4 states that breaks need not be postulated in those portions of piping from containment wall to and including the inboard or outboard isolation valves (the "break exclusion zone"), provided they meet certain specific design criteria for stress and fatigue limits, welding, pipe length, guard pipe assemblies, and full volumetric examination of welds. These existing break exclusion guidelines are for fluid system piping in the containment penetration area of current generation large light-water reactors and, therefore, are not directly applicable to NuScale.

If NuScale desires to treat the bolted connection of the RRVs and RVVs to a flange connected to the reactor vessel as a break exclusion area, then a justification for why this connection provides confidence that the probability of gross rupture is extremely low, must be provided for NRC staff review and acceptance. The justification will need to contain a discussion of the considerations outlined below.

1. Quantitative assessment of the probability of gross failure for the bolted flange connection
2. Specific design stress and fatigue limits
3. A comprehensive bolting integrity program in accordance with the recommendations and guidelines in NUREG-1339 (with additional detail provided in EPRI NP-5769, as referenced in NUREG-1339), as well as related NRC bulletins and generic letters
4. Local leakage detection (potentially similar in concept to leakage detection from reactor vessel heads) that will provide indication of leakage before gross bolt failure, such that the plant can shut down
5. Augmented inspection program requirements, which could include augmented procurement requirements for the bolting, ultrasonic in-service testing of the bolts of the bolted flange connection at some specific inspection frequency, periodic bolt replacement, etc.

The staff requests the applicant to clarify how they intend to treat the bolted connection as a break exclusion location and if so, provide justification with a discussion of the above considerations.