From:	Carolyn Lauron
To:	Justin Hawkins
Cc:	Greg Cranston; Jordan Glisan
Subject:	NRC Staff Response to Follow-up Questions after the November 30 Public Meeting re: Closed Systems Isolation Valves
Date:	Thursday, January 5, 2023 1:11:00 PM

Hi Justin –

Please find the NRC staff response below to the subject questions.
Please let us know if you have additional questions or need more information.

Thanks,
Carolyn Lauron
US NRC

Background: During the November 30, 2022, public meeting, "SMR-160 Closed Systems Isolation Valves," Holtec discussed the intent to not use containment isolation valves in the Primary Decay Heat Removal (PDHR) and Secondary Decay Heat Removal (SDHR) systems.

The NRC staff identified that when NuScale requested an exemption from General Design Criterion (GDC) 57 for a similar containment isolation scheme in their Decay Heat Removal System (DHRS), they also performed a Leak-Before-Break (LBB) or break exclusion analysis of the DHRS and asked if Holtec intended to perform a similar analysis.

We reviewed the NuScale exemption request, Final Safety Analysis Report (FSAR), and Final Safety Evaluation Report (FSER) and concluded that NuScale analyzed the piping systems outside of containment and found that they met the requirements of Branch Technical Position (BTP) 3-4 B.1(ii), "Fluid System Piping in Containment Penetration Areas," which states, "Breaks and cracks need not be postulated in those portions of piping from containment wall to and including the inboard or outboard isolation valves…" provided they meet the listed criteria. We also note NuScale states in FSAR Section 3.6.2.1.2, "Although the DHRS condenser is manufactured from piping products, it is considered a major component and not a piping system; thus, breaks are not postulated."

We also note that BTP 3-4 B.1(iii), "Postulation of Pipe Breaks in Areas Other Than Containment Penetration," states, "With the exception of piping identified in 2.A(ii) [*Holtec's assumption is this is a typo meant to be B.1(ii)*], breaks… should be postulated at the following locations in each piping and branch run: (a) at terminal ends…"

Terminal ends, as defined by BTP 3-4, are, "the extremities of piping runs that connect to structures, components (e.g., vessels, pumps, valves), or pipe anchors that act as rigid constraints to piping motion and thermal expansion…"

Question: Is the connection between the NuScale DHRS piping and the DHRS condenser considered a terminal end that requires a break to be postulated? Or was the entire DHRS piping system outside containment considered within the "containment penetration area" and therefore breaks at those terminal ends need not be postulated?

NRC Staff Response:
As stated in Standard Review Plan (SRP) Section 6.2.4, "Containment Isolation System," containment isolation provisions for lines in engineered safety features or engineered safety feature-related systems normally consist of two isolations valves (CIVs) in series.[1] Slide 11 of the Holtec's presentation described two justifications: (1) a closed system forming the second containment barrier, and (2) the piping integrity analysis using SRP Section 3.6.2, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping," or a leak-tight housing for the section of piping associated with the eliminated containment isolation valve.[2], [3]

SRP Section 3.6.2 and its associated BTP 3-4, "Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment," provides, in part, guidelines acceptable to meet the GDC 4, "Environmental and Dynamic Effects Design Bases," requirements to ensure that structures, systems, and components (SSCs) important to safety be designed to accommodate the effects of postulated accidents, including appropriate protection against the effects of postulated pipe ruptures.[4], [5] It provides the screening criteria for plant designers to use for selecting pipe break locations, break types and sizes, and leakage cracks. It also provides the staff's guidelines for applying break exclusion such that breaks are not postulated for the break exclusion area.

Note that the term "break" in this context is only related to the potential to exclude consideration of dynamic effects per GDC 4, and is not associated with hypothetical reactor coolant pressure boundary breaks required for establishing the design-basis of the emergency core cooling system per 10 CFR 50.46.[6]

The NRC staff's guidance in BTP 3-4 provides certain design and inspection provisions to ensure an extremely low probability of piping failure for the break exclusion that includes:

- Criteria for stress and fatigue usage factor for American Society of Mechanical Engineers (ASME) Class 1 piping,
- Stress Criteria for ASME Class 2 piping,
- Avoid welded attachment (for pipe support or other purposes) to these portions of piping,
- Number of circumferential and longitudinal piping welds and branch connections should be minimized,
- Reduce the length of these portions of piping the minimum length practical,
- The design of pipe anchor or restraints should not need welding directly to the outer surface of the piping,
- Design criteria for guard pipes, and
- Augmented 100% volumetric ISI of all pipe welds including the welded connections (e.g., terminal ends).

It should be noted that BTP 3-4 guidance allows breaks associated with high-energy fluid systems piping in containment penetration areas to be excluded from the design basis. The containment penetration area is defined by regulatory guidance as the run of piping from the inside CIV to the outside CIV. The NuScale DHRS piping extends beyond what would traditionally be considered a containment penetration area. For the NuScale design, break exclusion criteria are applied to the DHRS piping outside containment. To justify its application of the break exclusion for the DHRS piping outside containment, NuScale demonstrated its design meets the provisions in BTP 3-4 and specified a 100-percent

volumetric inservice examination for all the pipe welds including the welded connections within the break exclusion areas.

If Holtec plans to apply break exclusion criteria to its design, the applicant should adequately demonstrate how its design meets the provisions in BTP 3-4 and specify a 100-percent volumetric inservice examination for all the pipe welds (including the terminal ends) within the break exclusion areas to meet the applicable BTP 3-4 break exclusion criteria in the NRC's guidance.

References:

1. US NRC, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 6, "Engineered Safety Features," Section 6.2.4, "Containment Isolation System," Revision 3, dated March 2007, Agencywide Documents and Access Management System (ADAMS) Accession No. ML070380192.
2. SMR, LLC, "Enclosure 1: SMR, LLC, Preapplication Meeting Presentation on Overview of SMR-160 PDHR," dated November 1, 2022, ML22305A510, part of ML22305A508.
3. US NRC, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 3, "Design of Structures, Components, Equipment, and Systems," Section 3.6.2, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping," Revision 3, dated December 2016, ML16088A041.
4. US NRC, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 3, "Design of Structures, Components, Equipment, and Systems," Branch Technical Position 3-4, "Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment," Revision 3, dated December 2016, ML16085A315.
5. Title 10 of the Code of Federal Regulations (10 CFR), Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," GDC 4, "Environmental and Dynamic Effects Design Bases."
6. 10 CFR Part 50, Section 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors."