RAIO-0918-61813

Docket No. 52-048

September 17, 2018

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 495 (eRAI No. 9565) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 495 (eRAI No. 9565)," dated July 18, 2018

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 9565:

- 03.09.06-28

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9565

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9565

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9565
Date of RAI Issue: 07/18/2018

NRC Question No.: 03.09.06-28

The NRC regulations in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 specify principal design criteria to establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components (SSCs) important to safety; that is, SSCs that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. With respect to containment isolation valves (CIVs), General Design Criterion (GDC) 54, "Piping systems penetrating containment," in 10 CFR Part 50, Appendix A, requires that piping systems penetrating primary reactor containment shall be provided with leak detection, isolation, and containment capabilities having redundancy, reliability, and performance capabilities which reflect the importance to safety of isolating these piping systems. GDC 54 also requires that such piping systems shall be designed with a capability to test periodically the operability of the isolation valves and associated apparatus and to determine if valve leakage is within acceptable limits. GDC 55, "Reactor coolant pressure boundary penetrating containment," in 10 CFR Part 50, Appendix A, requires that each line that is part of the reactor coolant pressure boundary (RCPB) and that penetrates primary reactor containment shall be provided with CIVs as specified in this GDC, unless it can be demonstrated that the containment isolation provisions for a specific class of lines, such as instrument lines, are acceptable on some other defined basis. GDC 56, "Primary containment isolation," in 10 CFR Part 50, Appendix A, requires that each line that connects directly to the containment atmosphere and penetrates primary reactor containment shall be provided with CIVs as specified in this GDC, unless it can be demonstrated that the containment isolation provisions for a specific class of lines, such as instrument lines, are acceptable on some other defined basis. GDC 57, "Closed system isolation valves," in 10 CFR Part 50, Appendix A, requires that each line that penetrates primary reactor containment and is neither part of the RCPB nor connected directly to the containment atmosphere shall have at least one CIV which shall be either automatic, or locked closed, or capable of remote manual operation.

NuScale FSAR (Revision 1) Tier 2, Section 6.2.4.2.2, "Component Design," indicates the primary system containment isolation valves (PSCIVs) consist of a single body with two ball valves in series. Section 6.2.4.2.2 states that the PSCIV ball valve operation is based on a hemispherical design that rotates such that the ball presses into the valve seat to close the valve. Section 6.2.4.2.2 indicates that the secondary system containment isolation valves (SSCIVs) consist of a single ball valve design with the ball positioned off-center to provide for a tight seal on both the upstream and downstream metal seats. Similarly, Section 6.2.6.3, "Containment Isolation Valve Leakage Rate Test," states that the CIVs are a wedged, quarter-turn ball valve type. Figure 6.2-7, "Containment Isolation Valve Actuator Hydraulic Schematic," indicates a rack and pinion arrangement for the operation of the CIVs by a gas bottle actuator. Section 20.1.2.2, "Applicable Structures, Systems, and Components," in Chapter 20, "Mitigation of Beyond-Design-Basis Events," states that the CIVs fail-safe to their closed position using stored energy, and references Section 6.2.4 for details of the CIV design and function.

During discussions regarding the NuScale reactor response to a long-term loss of ac power, NuScale personnel stated that the CIVs are assumed to remain closed for their design-basis and beyond-design-basis functions following closure. The NRC staff notes that the rack and pinion arrangement for operation of the CIVs might retain residual torque that could reopen or unseal the valve following depletion of the gas bottle actuator. Therefore, the NRC staff requests that NuScale revise FSAR Tier 2, Section 6.2.4, to specify that each ball valve in the PSCIVs and SSCIVs will be designed and qualified for torque closure using the gas bottle actuator to provide sufficient wedging and sealing to prevent reopening and unsealing of each ball valve following depletion of the gas bottle actuator for the extended time period for the design-basis and beyond-design-basis functions assumed for each individual ball valve. The staff also requests that NuScale confirm that the different descriptions of the ball valves and their operation for the PSCIVs and SSCIVs in FSAR Tier 2, Section 6.2.4.2.2, are not intended to indicate any differences in the PSCIV and SSCIV design.

NuScale Response:

FSAR Section 6.2.4.2 is revised to indicate that the PSCIVs and the SSCIVs are designed and qualified for torque closure using pneumatic pressure to provide sufficient wedging and sealing to prevent reopening and unseating of each ball valve for the extended time period for the design-basis and beyond-design-basis functions assumed for each individual ball valve.

The PSCIV and SSCIV design description is clarified to indicate that the ball valve rotates such that the ball presses into the valve seat to close the valve. This provides an additional force holding the valve closed since the ball compresses the valve seat when closing.

Additionally, the PSCIV design description is clarified to indicate that the design includes a thermal relief device to relieve fluid back to the CNV, to prevent thermal binding. The thermal relief device is integral to the PSCIV.

Impact on DCA:

FSAR Section 6.2 has been revised as described in the response above and as shown in the markup provided in this response.

intent of GDC 55 and 56 and to the guidance of RG 1.11 by restricting the instrumentation process lines to within the containment pressure boundary.

6.2.4.2.2 Component Description

The valves used to isolate process lines penetrating the containment are of two basic designs. One design consists of a configuration of two valves (obturators) contained within a single valve body used for the PSCIVs. The second design is a single valve design used for SSCIVs.

RAI 03.09.06-28

As shown in Figure 6.2-5, the dual-valve, single-body PSCIV design consists of two valves (fully independent balls, seats, and actuators) within a single valve body welded to a CNV nozzle safe-end. Each valve is a ball type design arranged in a cartridge configuration where the ball, seat, and seals are removed as an assembly from the valve body for maintenance, repair, or replacement. Valve operation is based on a ~~hemispherical~~ball valve design that rotates such that the ball presses into the valve seat to close the valve.

In accordance with the regulatory requirements for redundancy, each PSCIV assembly contains two, independent balls and actuators. The single body design welded to a nozzle safe-end places the inboard CIV as close to the CNV as possible and eliminates the potential for a line break between the two valves in series. The I&C for each valve within a PSCIV assembly are provided by independent divisions of the MPS.

RAI 05.02.01.01-7

The PSCIVs connected to lines that directly contact the reactor coolant (RCS injection, RCS discharge, PZR spray, and RPV high-point degasification) during normal operation are ~~designed and constructed~~designed, fabricated, constructed, tested and inspected in accordance with the ASME Code, Section III, Class 1, Subsection NB, Quality Group A, and Seismic Category I criteria. The PSCIVs on the ~~other~~CRDS, CES and CFDS lines are designed and constructed as Class 1; however, these valves are classified the same as the lines, which are not part of the RCPB inside of containment. These PSCIVs are Quality Group B components and are on lines ~~designed and constructed~~designed, fabricated, constructed, tested and inspected in accordance with ASME Code, Section III, Class 2, Subsection NC, Quality Group B, and Seismic Category I criteria.

RAI 03.09.06-28

As shown in Figure 6.2-6a and Figure 6.2-6b, the single valve design consists of one ball-type valve in a cartridge configuration like the PSCIVs. The SSCIVs have a ball, seat, and seals that allow for removal as an assembly from the valve body for maintenance, repair, or replacement. Valve operation is based on ~~a design with the ball positioned off-center to provide for a tight seal on both the upstream and downstream metal seats.~~a ball valve design that rotates such that the ball presses into the valve seat to close the valve.

RAI 05.02.01.01-7

The SSCIVs are designeddesigned, fabricated, constructed, tested and inspected to the ASME Code, Section III, Class 2, Subsection NC, Quality Group B, and Seismic Category I criteria. The FWIVs, MSIVs, and main steam isolation bypass valves are designed to these criteria. The MSIVs and main steam isolation bypass valves are welded to a short section of piping that is welded directly to a CNV top head nozzle safe-end. The FWIVs are welded to a CNV top head nozzle safe-end.

RAI 05.02.01.01-7

The PSCIV materials, including weld materials, conform to fabrication, construction, and testing requirements of ASME BPVC, Section III, Subsection NB. The materials selected for fabrication conform to the applicable material specifications provided in ASME BPVC, Section II and meet the requirements of ASME BPVC, Section III, Article NB-2000. The SSCIV and MS piping materials, including weld materials, conform to fabrication, construction, and testing requirements of ASME BPVC, Section III, Subsection NC. The materials selected for fabrication conform to the applicable material specifications provided in ASME BPVC, Section II and meet the requirements of ASME BPVC, Section III, Article NC-2000. The PSCIVs, SSCIVs and MS piping are constructed of materials with a proven history in light water reactor environments. Surfaces of pressure retaining parts of the valves, including weld filler materials and bolting material, are corrosion resistant materials such as stainless steel or nickel-based alloy.

RAI 05.02.01.01-7

Attachment welding of the PSCIVs are conducted utilizing procedures qualified in accordance with the applicable requirements of ASME BPVC, Section III, Subarticle NB-4300 and Section IX. Welding of the SSCIVs and short section of MS piping are conducted utilizing procedures qualified in accordance with the applicable requirements of ASME BPVC, Section III, Subarticle NC-4300 and Section IX.

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When the PSCIVs are actuated to close, the fluid between the two valves could then heat up. Design overpressure for this condition is taken into consideration in the dual valve design. As the fluid heats up and expands, the pressure increase that is applied in the direction against the inboard valve ball changes the force balance on the hemispherical ball and unseats the ball to open a gap between the ball and the seat to relieve the excess pressure to the CNV.causes a thermal relief device to relieve fluid back to the CNV. The thermal relief device is integral to the PSCIV.

The PSCIV design provides a bonnet closure with a double seal with a test connection in the space between the seals to allow for detection of leakage past the valve bonnet seals. The valve design also provides for Appendix J, Type C testing via the use of "testing only" and "inservice" test inserts that allow the pressurization of each of the two valves (Figure 6.2-5).

RAI 03.09.06-28, RAI 06.02.04-2

Hydraulic actuators are used for both PSCIV and SSCIV designs. Each actuator is equipped with a hydraulic cylinder applying opening force to the valve and a pneumatic cylinder that applies closing force to the valve. To open the valve,

hydraulic pressure is increased to exceed the force applied by the passive pneumatic cylinder. To close the valve, hydraulic fluid is vented, allowing the passive pneumatic cylinder pressure force to exceed the hydraulic pressure force. The PSCIV and SSCIV designs are designed and qualified for torque closure using pneumatic pressure to provide sufficient wedging and sealing to prevent reopening and unseating of each ball valve for the extended time period for the design-basis and beyond-design-basis functions assumed for each individual ball valve. The pneumatic cylinders are precharged with nitrogen prior to plant operation. The hydraulic cylinders are pressurized by a ~~non-safety related~~ hydraulic skid and vented by redundant safety related pilot valves. The hydraulic skid is classified as safety-related; however, the only safety-related components contained on the skid are the safety-related pilot valves and associated vent path.

RAI 06.02.04-2, RAI 10.03-5

Two styles of actuators are used: standard capacity and high capacity. The standard capacity actuator consists of pilot solenoid valves arranged in two parallel vent paths (refer to Figure 6.2-7). The high capacity actuator consists of pilot solenoid valves and pilot dump valves arranged in two parallel vent paths (refer to Figure 6.2-7). For the high capacity actuator, the pilot solenoid valve actuates the pilot dump valve. Actuating the pilot dump valve vents the hydraulic line, thereby closing the valve. The pilot valves are remotely located on hydraulic skids. Figure 6.2-8 depicts the relationship between the CIVs, their pilot valve subcomponents and hydraulic skids. The two hydraulic skids are located in separate areas of the RXB.

RAI 06.02.04-2

The pilot solenoid valves are controlled by the module protection system (MPS) as described by Chapter 7. The CIVs fail to the safe (closed) position.

6.2.4.2.2.1 Piping Systems Connected to the Reactor Coolant Pressure Boundary

Isolation of each containment penetration that is part of the RCPB (RCS injection, RCS discharge, RCS high point degasification and pressurizer spray) is provided by a dual valve, single body PSCIV.

When closed, the PSCIVs isolate the reactor coolant in the primary systems that penetrate the CNV from the outside environment. In accordance with regulatory requirements for redundancy, two separate valves are incorporated into each single valve body.

The NuScale design of the PSCIVs on these lines locates both valves outside of the harsh CNV environment which is a justified approach for meeting GDC 55 for penetrations with lines containing reactor coolant. Compliance with GDC 55 is discussed in Section 3.1.5.

RAI 06.02.04-2

Each PSCIV is remotely operated from the main control room with valve position indicated and each valve automatically closes under accident conditions that require containment isolation. These valves also are designed