NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Friday, February 02, 2018 1:09 PM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Dudek, Michael; Lavera, Ronald; Markley, Anthony
Subject: Request for Additional Information No. 361 RAI No. 9285 (8.1)
Attachments: Request for Additional Information No. 361 (eRAI No. 9285).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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From: Cranston, Gregory

Created By: Gregory.Cranston@nrc.gov

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Request for Additional Information No. 361 (eRAI No. 9285)

Issue Date: 02/02/2018
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 12.03-12.04 - Radiation Protection Design Features
Application Section: 12.3, 11.4,

QUESTIONS

12.03-41

Regulatory Basis

10 CFR 52.47(a)(5) requires applicants to identify the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radiation exposures within the limits of 10 CFR Part 20. 10 CFR 20.1101(b) and 10 CFR 20.1003, require the use of engineering controls to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is practical. 10 CFR 20.1701 requires the use of process or engineering controls to minimize the potential for internal exposure to radioactive material.

10 CFR 52.47(a) (22) requires applicants to demonstrate how the operating experience insights have been incorporated into the plant design.

Appendix A to Part 50—General Design Criteria (GDC) for Nuclear Power Plants, Criterion 61—"Fuel storage and handling and radioactivity control," requires systems which may contain radioactivity to be designed with suitable shielding for radiation protection and with appropriate containment, confinement, and filtering systems.

The DSRS Acceptance Criteria section of NuScale DSRS section 12.3-12.4 "Radiation Protection Design Features," states that the applications should describe how operating experience insights have been incorporated into the plant design, to reduce maintenance and improve reliability.

Background

DCD Tier 2 Revision 0 11.4.2.5.2, "Pumps," states that two spent resin storage tank transfer pumps are used to take suction from the decant portion of the resin storage tanks and provide water to sluice spent resins from the pool clean up system (PCUS) and the chemical and volume control system (CVCS) demineralizers to a spent resin storage tank (SRST). This provides the motive force to sluice resins, while minimizing the generation of radioactive waste. These pumps can also be used to fluff the spent resins inside the SRST by recirculating decant water prior to transferring spent resins to a high integrity container (HIC). A similar arrangement exists for the phase separator tank (PST).

DCD Figure 11.4-2a: "Process Flow Diagram for Wet Solid Waste," and DCD Figure 11.4-2b: "Solid Radioactive Waste System Diagram," show a line from the Service Air system that is separated from the suction of the resin transfer pumps by a single isolation valve. The use of a single isolation valve increases the risk for air intrusion due to valve leakage or misalignment. Based on information made available to the staff during the RPAC Chapter 12 Audit, the suction isolation valves for the pumps appear to be diaphragm disk valves. This information appears to be consistent with DCD Section 11.4.2.5.3, "Piping and Valves," which states that valves in slurry transfer lines are full-ported ball valves and liquid process valves are diaphragm valves. Operating experience is available (e.g., Electric Power Research Institute (EPRI) Technical Report (TR) 105852 Volume 1 "Valve Application, Maintenance, and Repair Guide,") to the staff that indicates that leaks past seats of these types of valves can occur as a result of poor stem travel adjustment, diaphragm age and over setting the stem travel. Typically, these types of valves are not in a periodic performance testing (i.e., leakage testing) program, and the staff has not seen any information that indicates that they are in a performance testing program.

Information made available to the staff during the RPAC Chapter 12 Audit indicated that these pumps are centrifugal pumps with an open impeller type. However, none of the information in the DCD application, or that was in information made available to the staff during the audit indicated what design features were provided to:

- Vent the pump seal
- minimize seal damage from air intrusion,
- prevent pump wearing ring binding due to air intrusion,
- vent air out of the pump casing and seal following air intrusion,
- ensure that sufficient level is in the associated resin storage tank(s) to prevent running the pumps dry

In addition to the aforementioned items related to pump failures due to air intrusion, as stated in DCD Section 11.4.2.5.2, the pumps are used to take a suction through the back wash screens. Operating experience available (e.g., NUREG/CR-4245, "In-Plant Source Term Measurements at Brunswick Steam Electric Station", NUREG/CR-6365, "Steam Generator Tube Failures") to the staff indicates that it is not uncommon for particulate matter smaller than the resin retention screen mesh size (i.e., corrosion and wear products, and “resin fines”) to pass through these screens. After passing through the screens, this particulate matter can cause damage to sealing surfaces, and accumulate in downstream components. The wear on sealing surfaces result in increased maintenance, while the accumulation of radioactive waste products causes increased dose rates, and subsequent occupational radiation worker exposure.

DCD Section 12.3.1.1.4, “Pumps,” states that pump leakage is reduced by using canned pumps whenever they are compatible with service needs, and the liquid radioactive waste system (LRWS) uses double diaphragm pumps to reduce leakage and minimize repair times. However, based on information contained in the DCD and information made available to the staff during the RPAC Chapter 12 Audit, the staff was unable to see how these types of requirements were implemented.

Because working on plant components handling radioactive waste frequently involve high dose rates, high beta-gamma contamination levels, and may involve high transuranic contamination levels, the potential for high occupational radiation exposure (ORE) is elevated.

Key Issue 1:
The physical arrangement of the service air line with the resin transfer pumps, and the absence of design features to prevent pump air binding, or pump damage, does not appear to address operating experience (e.g., EPRI TR-1026498 “Report of the Expert Panel on the Effect of Gas Accumulation on Pumps), and may result in increased ORE.

Question 1:
To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions, with respect to radiation protection design features provided to reduce ORE, the staff requests that the applicant:

- Please describe the type of pump (e.g., sealed) used for the resin transfer pumps
- Please describe the design features provided to prevent air intrusion into the pumps and seals,
- Please describe the design features provided for removing air from the pump/seal, should air intrusion occur,
- Please describe any level controls provided to maintain water in the resin transfer pumps,
- As necessary, revise the DCD Section 12.3-12.4 to include information related to ensuring the reliability of the resin transfer pumps,

OR

Provide the specific alternative approaches used and the associated justification.

12.03-42

Regulatory Basis

10 CFR 52.47(a)(5) requires applicants to identify the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radiation exposures within the limits of 10 CFR Part 20. 10 CFR 20.1101(b) and 10 CFR 20.1003, require the use of engineering controls to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is practical. 10 CFR 20.1701 requires the use of process or engineering controls to minimize the potential for internal exposure to radioactive material.

10 CFR 52.47(a) (22) requires applicants to demonstrate how the operating experience insights have been incorporated into the plant design.

Appendix A to Part 50—General Design Criteria (GDC) for Nuclear Power Plants, Criterion 61—“Fuel storage and handling and radioactivity control,” requires systems which may contain radioactivity to be designed with suitable shielding for radiation protection and with appropriate containment, confinement, and filtering systems.

The DSRS Acceptance Criteria section of NuScale DSRS section 12.3-12.4 “Radiation Protection Design Features,” states that the applications should describe how operating experience insights have been incorporated into the plant design, to reduce maintenance and improve reliability.

Background

DCD Tier 2 Revision 0 11.4.2.5.2, “Pumps,” states that two spent resin storage tank transfer pumps are used to take suction from the decant portion of the resin storage tanks and provide water to sluice spent resins from the pool clean up system (PCUS) and the chemical and volume control system (CVCS) demineralizers to a spent resin storage tank (SRST). This provides the motive force to sluice resins, while minimizing the generation of radioactive waste. These pumps can also be used to fluff the spent resins inside the SRST by recirculating decant water prior to transferring spent resins to a high integrity container (HIC). A similar arrangement exists for the phase separator tank (PST).

DCD Figure 11.4-2a: “Process Flow Diagram for Wet Solid Waste,” and DCD Figure 11.4-2b: “Solid Radioactive Waste System Diagram,” show a line from the Service Air system that is separated from the suction of the resin transfer pumps by a single isolation valve. The use of a single isolation valve increases the risk for air intrusion due to valve leakage or misalignment. Based on information made available to the staff during the RPAC Chapter 12 Audit, the suction isolation valves for the pumps appear to be diaphragm disk valves. This information appears to be consistent with DCD Section 11.4.2.5.3, “Piping and Valves,” which states that valves in slurry transfer lines are full-ported ball valves and liquid process valves are diaphragm valves. Operating experience is available (e.g., Electric Power Research Institute (EPRI) Technical Report (TR) 105852 Volume 1 “Valve Application, Maintenance, and Repair Guide,”) to the staff that indicates that leaks past seats of these types of valves can occur as a result of poor stem travel adjustment, diaphragm age and over setting the stem travel. Typically, these types of valves are not in a periodic performance testing (i.e., leakage testing) program, and the staff has not seen any information that indicates that they are in a performance testing program.

Information made available to the staff during the RPAC Chapter 12 Audit indicated that these pumps are centrifugal pumps with an open impeller type. However, none of the information in the DCD application, or that was in information made available to the staff during the audit indicated what design features were provided to:

- Vent the pump seal
- minimize seal damage from air intrusion,
- prevent pump wearing ring binding due to air intrusion,
- vent air out of the pump casing and seal following air intrusion,
- ensure that sufficient level is in the associated resin storage tank(s) to prevent running the pumps dry

In addition to the aforementioned items related to pump failures due to air intrusion, as stated in DCD Section 11.4.2.5.2, the pumps are used to take a suction through the back wash screens. Operating experience available (e.g., NUREG/CR-4245, "In-Plant Source Term Measurements at Brunswick Steam Electric Station", NUREG/CR-6365, "Steam Generator Tube Failures") to the staff indicates that it is not uncommon for particulate matter smaller than the resin retention screen mesh size (i.e., corrosion and wear products, and “resin fines”) to pass through these screens. After passing through the screens, this particulate matter can cause damage to sealing surfaces, and accumulate in downstream components. The wear on sealing surfaces result in increased maintenance, while the accumulation of radioactive waste products causes increased dose rates, and subsequent occupational radiation worker exposure.

DCD Section 12.3.1.1.4, “Pumps,” states that pump leakage is reduced by using canned pumps whenever they are compatible with service needs, and the liquid radioactive waste system (LRWS) uses double diaphragm pumps to reduce leakage and minimize repair times. However, based on information contained in the DCD and information made available to the staff during the RPAC Chapter 12 Audit, the staff was unable to see how these types of requirements were implemented.

Because working on plant components handling radioactive waste frequently involve high dose rates, high beta-gamma contamination levels, and may involve high transuranic contamination levels, the potential for high occupational radiation exposure (ORE) is elevated.

Key Issue 2:
The application does not contain appropriate supporting information concerning design features (e.g., resin screen mesh size, seal design parameters, etc.) provided to prevent pump/seal damage from corrosion products and resin fines, and does not appear to address operating experience, which may result in increased ORE.

Question 2:
To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to radiation protection design features provided to reduce ORE,, the staff requests that the applicant:

- Please describe the design features of the resin retention elements used to provide protection of the pumps/seals,
- Please describe the design features provided to increase pump/seal reliability,
- As necessary, revise the DCD Section 12.3-12.4 to include information related ensuring the reliability of the resin transfer pumps/seals,

OR

Provide the specific alternative approaches used and the associated justification.