RAIO-0318-59019

March 9, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 361 (eRAI No. 9285) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 361 (eRAI No. 9285)," dated February 02, 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 Questions from NRC eRAI No. 9285:

- 12.03-41
- 12.03-42

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 Steven Mirsky at 240-833-3001 or at smirsky@nuscalepower.com.

Sincerely,

Jennie Wike
Manager, Licensing
NuScale Power, LLC

Distribution: Samuel Lee, NRC, OWFN-8G9A
Anthony Markley, NRC, OWFN-8G9A
Prosanta Chowdhury NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9285

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9285

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

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

eRAI No.: 9285
Date of RAI Issue: 02/02/2018

NRC Question No.: 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.

NuScale Response:

10 CFR 52.47(a)(22) requires applicants to demonstrate how operating experience insights have been incorporated into the plant design. Regulatory Guide 1.206 and NUREG-0800 define operating experience insights specifically as NRC generic letters and bulletins issued after the most recent revision of the applicable standard review plan and six months prior to the docket date of the application. None of the cited references in this RAI meet the definition of operating experience.

1. *Please describe the type of pump (e.g., sealed) used for the resin transfer pumps*

The SRST and PST transfer pumps are stated in FSAR Table 11.4-1 as being seal-less pumps.

---

2. *Please describe the design features provided to prevent air intrusion into the pumps and seals*

To prevent air intrusion into the SRWS transfer pumps, the service air is isolated from the suction side of the transfer pumps by at least two valves. To illustrate the separation of service air from the transfer pump suction, FSAR Figures 11.4-2a and 11.4-2b are annotated with yellow and blue colored lines to show the system configurations during an air sparging operation and a transfer pump operation.

For the air sparging operation figures, the yellow colored lines indicate the pipes that will be filled with service air during an air sparging operation. It can be seen that there are two isolation valves between the service air and the transfer pump suctions. This mode of operation is expected to be infrequent.

Similarly, for the transfer pump operation figures, the blue colored lines indicate the pipes that will be filled with decant water during a transfer pump operation, and the yellow colored lines still indicate pipes filled with service air. The pump transfer operation figures show there are at least two isolation valves between the service air and the transfer pump suctions.

3. *Please describe the design features provided for removing air from the pump/seal, should air intrusion occur*

Air intrusion from the service air supply would enter these pumps as an inadvertent, or accidental occasion. A demineralized water connection is available to the suction side of these pumps to provide flushing water to flush the pump discharge lines after resin transfer. This demineralized water connection, in conjunction with pump operation, can also be used to flush out air that has inadvertently entered the pump suction line.

4. *Please describe any level controls provided to maintain water in the resin transfer pumps*

There is no automatic level control associated with the transfer pump operation and the selected decant level on the respective storage tank. The level indication instruments are capable of monitoring both liquid and resin levels simultaneously. Operators manually select the appropriate decant port based on instrument level readings and procedural instructions.

Impact on DCA:

There are no impacts to the DCA as a result of this response.

Figure 11.4-2a: Process Flow Diagram for Wet Solid Waste
Air Sparging Operation

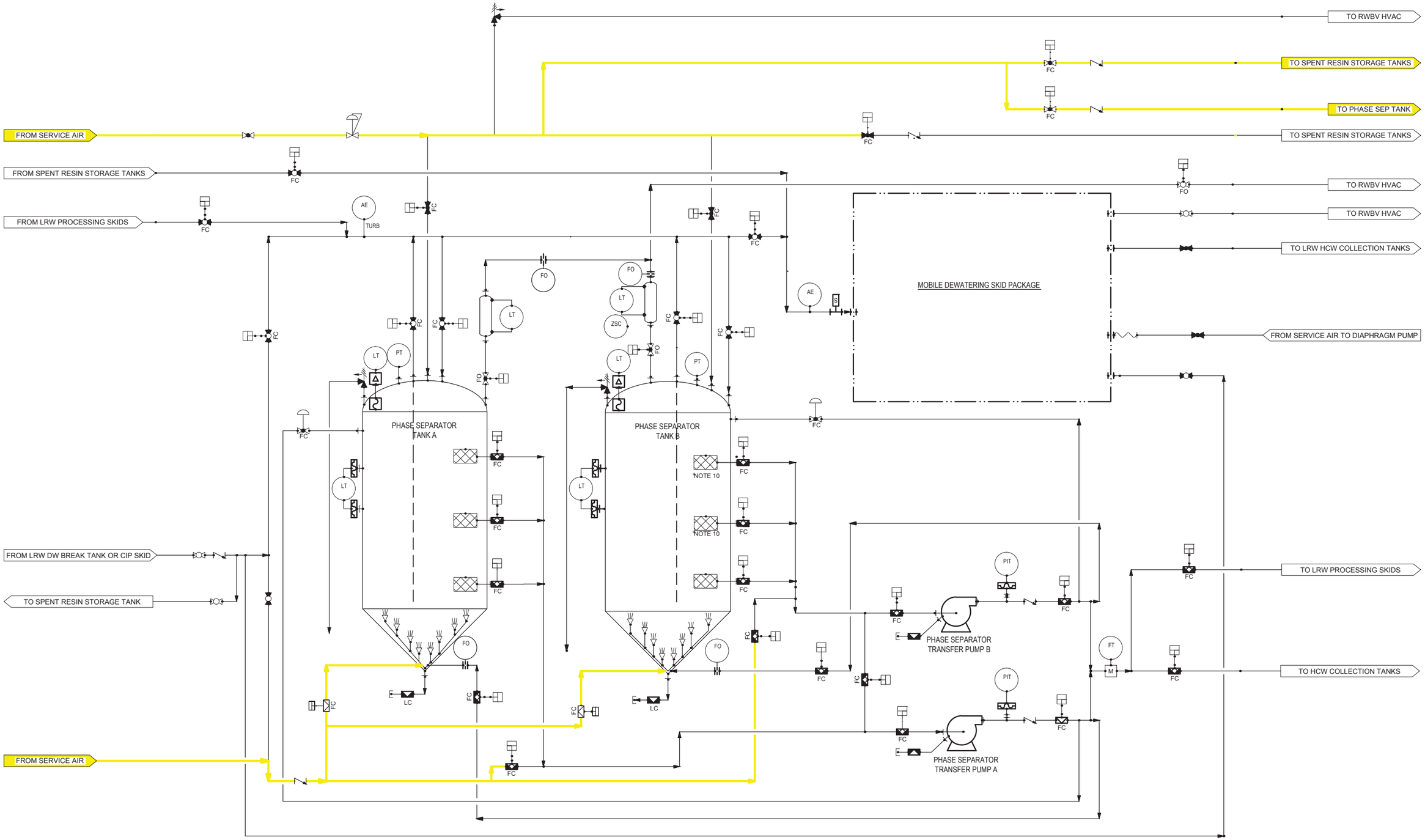


Figure 11.4-2b: Solid Radioactive Waste System Diagram
Air Sparging Operation

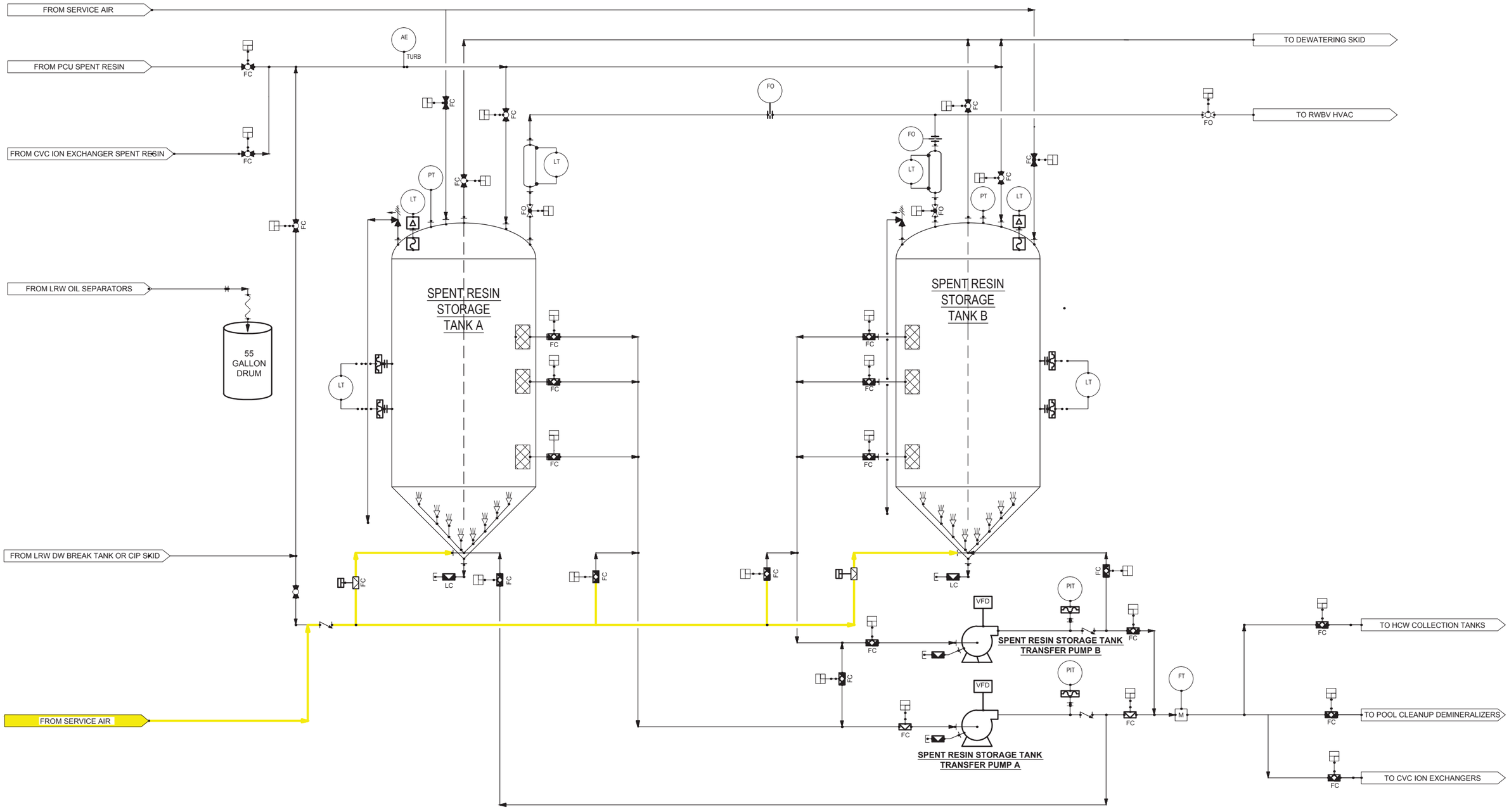


Figure 11.4-2a: Process Flow Diagram for Wet Solid Waste Pump Transfer Operation

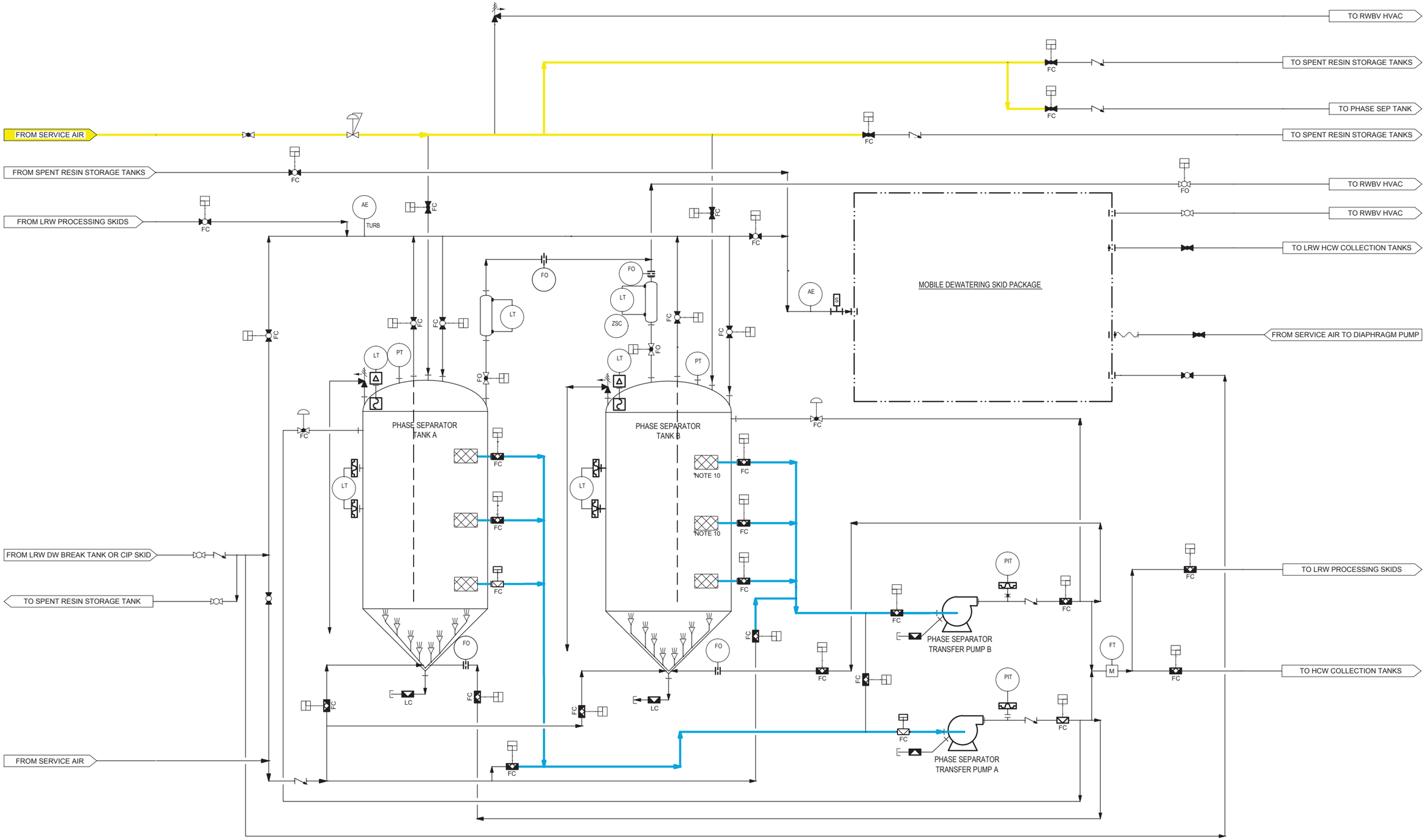
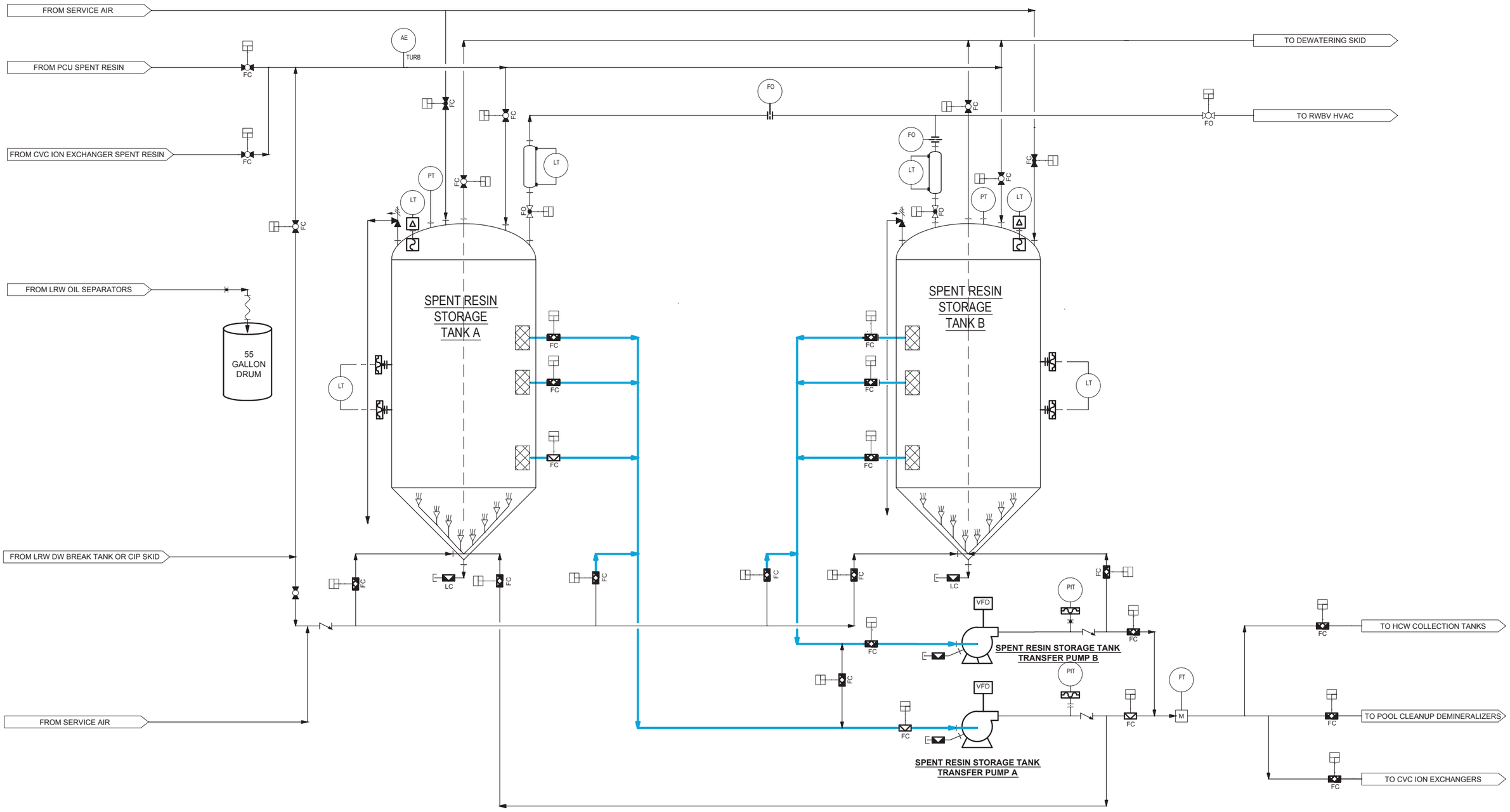


Figure 11.4-2b: Solid Radioactive Waste System Diagram
Pump Transfer Opearation



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

eRAI No.: 9285
Date of RAI Issue: 02/02/2018

NRC Question No.: 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.

NuScale Response:

10 CFR 52.47(a)(22) requires applicants to demonstrate how operating experience insights have been incorporated into the plant design. Regulatory Guide 1.206 and NUREG-0800 define operating experience insights specifically as NRC generic letters and bulletins issued after the most recent revision of the applicable standard review plan and six months prior to the docket date of the application. None of the cited references in this RAI meet the definition of operating experience.

1. *Please describe the design features of the resin retention elements used to provide protection of the pumps/seals*

Because the NuScale SRST and PST transfer pumps are of the seal-less type, there are no pumps seals to protect. The NuScale design includes the use of screens inside the SRST and PST to minimize the size and amount of resins and resin fines from escaping the vessels. The specific mesh size will be determined at a later date, when the specific system component designs are finalized.

---

2. *Please describe the design features provided to increase pump/seal reliability*

The pumps are specified as seal-less with open impellers which are suitable for slurry operation. In addition, demineralized water can be supplied to the suction of the pumps for flushing the discharge lines out after the resin transfer is complete. This will also remove air that has potentially entered the pump.

Impact on DCA:

There are no impacts to the DCA as a result of this response.