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TASK REQUIREMENTS AND CRITERIA DOCUMENT

Saltstone Facility Disposal Unit #6 Project, Bldg. 451-006Z (U)

Modification Traveler (MT): MT-SS-2011-00010

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SUMMARY OF REVISIONS

Date	Revision	Summary of Revision
11/16/2011	0	Initial Issue for Conceptual Design
03/28/2012	1	Issue for Preliminary Design. Incorporation of completed PCHA Revision A requirements.
06/28/2012	2	Issued for Tank Design Request for Proposal (RFP) bid package consistency and resolution of Critical Decision (CD) – 1 package alignment. This revision was made to make this document consistent with the RFP bid and CD-1 package including cost estimating and risk management.
06/28/2012	3	Issue for PCHA Revision B alignment. This revision was made to incorporate PCHA changes from Revision A to B.
09/12/2012	4	Resolution of independent Formal Design Review Comments performed by SRR
11/07/2012	5	Resolution of CD 2/3A DOE Comments and SDU loading constraints for Balance of Plant (BOP) design.
6/13/13	6	Revised to eliminate scope per LWO System Plan Rev. 18 - Inputs and Assumptions

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LIST OF ACRONYMS

AC	Alternating Current
ACI	American Concrete Institute
AHA	Automated Hazard Analysis
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ARP	Actinide Removal Process
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BCP	Baseline Change Package
CBU	Closure Business Unit
CHA	Consolidated Hazard Analysis
CHAP	Consolidated Hazard Analysis Process
CLFL	Composite Lower Flammability Limit
CFR	Code of Federal Regulation
Ci/gal	Curies per gallon
cm	centimeter
DA	Design Authority
DAS	Disposal Authorization Statement
DC	Design Constraint
DCS	Distributed Control System
DOE	Department of Energy
d/p	Differential Pressure
DSA	Documented Safety Analysis
DSS	Decontaminated Salt Solution
DWPF	Defense Waste Processing Facility
ECA	Environmental Compliance Authority
ETP	Effluent Treatment Process
F	Function
FHA	Fire Hazard Analysis
g/ml	grams per milliliter
GCL	Geosynthetic Clay Liner
GRI	Geosynthetic Research Institute
HC	Hazard Classification
HDPE	High Density Polyethylene
HEPA	High Efficiency Particulate Air
I & C	Instrumentation and Controls
IEEE	Institute of Electrical and Electronic Engineers
I/O	Input/Output
IR	Interface Requirement
ISWLF	Industrial Solid Waste Landfill
MCU	Modular Caustic-Side Solvent Extraction (CSSX) Unit
MIEES	Modular Instrument / Electrical Equipment Skid

MOV	Motor Operated Valve
mRad	milliRad
MRad	MegaRad
mrem	millirem
MT	Modification Traveler
NEMA	National Electrical Manufacturer's Association
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NPH	Natural Phenomena Hazard
OSHA	Occupational Safety and Health Administration
PA	Performance Assessment
PC	Performance Category
PCHA	Preliminary Consolidated Hazard Analysis
PFHA	Preliminary Fire Hazard Analysis
PLC	Programmable Logic Controller
ppm	Parts per Million
PR	Performance Requirement
PS	Production Support
Rad	Radiation Absorbed Dose
RAMI	Reliability, Availability, Maintainability, Inspectability
REM	Roentgen Equivalent Man
RFP	Request for Proposal
SA	Special Analysis
SCDHEC	South Carolina Department of Health and Environmental Control
scfh	Standard Cubic Feet per hour
scfm	Standard Cubic Feet per Minute
SDC	Seismic Design Category
SDF	Saltstone Disposal Facility
SDIT	Safety Design Integration Team
SDS	Safety Design Strategy
SDU	Saltstone Disposal Unit
SEE	System Engineering Evaluation
SFT	Salt Feed Tank
SG	Specific Gravity
SIL	Safety Integrity Level
SPCS	Saltstone Process Control System
SPF	Saltstone Production Facility
SRNL	Savannah River National Laboratory
SRR	Savannah River Remediation
SRS	Savannah River Site
SS	Safety Significant
SSCs	Structures, Systems, and Components
SWPF	Salt Waste Processing Facility
TED	Total External Dose
TR&C	Task Requirements and Criteria
UL	Underwriters Laboratories

VES	Value Engineering Study
WAC	Waste Acceptance Criteria
WSP	Waste Solidification Projects

LIST OF DEFINITIONS

Shall	The word "**shall**" is used to denote a requirement.
Shall Consider	The phrase "**shall consider**" is used when an objective assessment is to be performed in the subsequent design process to determine to what extent the specified consideration is to be incorporated. The basis for incorporation or rejection of the consideration shall be provided in the design process.

1.0 PLANT MODIFICATION SUMMARY

1.1 Programmatic Facility/Division Mission

The mission of the Saltstone Facility in Z-Area is to process and dispose of radioactive waste salt solution (Decontaminated Salt Solution (DSS)) from the tank farm facilities to meet the objectives identified in the Liquid Waste System Plan. Built in the 1980s, the Z-Area Saltstone Facility immobilizes the low level radioactivity waste salt solution by mixing it with a dry material mixture of fly ash, slag, and cement to produce a flowable grout mixture. This grout is poured into large concrete disposal units, where it cures to become saltstone, a leach-resistant solid monolith, for permanent disposal. Both the unset grout and cured grout (saltstone) are considered a non-hazardous waste form as defined by federal and state regulations.

The Saltstone Facility consists of two facility segments: The Saltstone Production Facility (SPF) and the Saltstone Disposal Facility (SDF). The SPF receives the DSS, produces the grout, and transfers the grout. The SDF disposes the grout in saltstone disposal units (SDUs). The SDF is permitted by the South Carolina Department of Health and Environmental Control (SCDHEC) as an Industrial Waste Landfill for disposal of non-hazardous solid waste. The saltstone monolith provides primary containment for the radionuclides and chemicals in the DSS and the SDUs provide secondary containment. Once all SDUs are filled and closure activities are complete, a backfilled engineering closure cap including soils, gravel, and liners will be placed above the SDUs within the SDF providing tertiary containment consistent with all applicable regulations.

The dry materials needed for grout production are unloaded from trucks and pneumatically conveyed to storage silos. The dry materials are discharged from the silos, weighed, and blended to produce premix. Salt solution is received from H-Area through the Inter-area Transfer System and temporarily held in a feed tank. The premix and salt solution are fed to a mixer in the 210-Z process room to produce saltstone grout. The grout is pumped to a concrete disposal cell, where it hardens to form saltstone. The hydration process that the grout undergoes as it cures is exothermic, and as a result, the grout temperature rises significantly after each grout pour. The magnitude of the temperature rise is dependent upon the grout pour rate. Elevated grout temperatures can increase the release rates of flammable organic solvents within the grout. The requirements for vapor space flammability safety controls and indications will be documented in the Documented Safety Analysis (DSA).

This Task Requirements and Criteria (TR&C) document relates to a new disposal unit (designated as Saltstone Disposal Units 6) required to accommodate salt waste processing. In accordance with the new Inputs and Assumptions document for the Liquid Waste System Plan Rev. 18

[Ref. 5.5.82] and draft Liquid Waste System Plan Rev. 18 [Ref. 5.5.56], the need date for SDU 6 is July 1, 2015. DSS from Actinide Removal Process (ARP)/ Modular Caustic-Side Solvent Extraction (CSSX) Unit (MCU) process will be the primary source to produce grout during saltstone filling operation of SDU 6. The combined DSS processing rates from this, starting in the fourth quarter of fiscal year 2015, will be nominally 6.0 million gallons per year.

1.2 General Plant Modification Scope

1.2.1 Plant Modification Scope Description

SDU 6 must provide adequate radiation shielding, interface with the modified saltstone process, and meet requirements as defined in South Carolina Department of Health and Environmental Control Regulation 61-107.19, SWM: Solid Waste Landfills and Structural Fill as well as other applicable state and federal environmental requirements. This document shall record the scope of work required to design, procure, construct, test, and turnover for operation a new single minimum 30 million gallon saltstone disposal cell designated as SDU 6. The scope shall also include some site preparation and tie-ins to existing processes and infrastructure.

The project scope includes:

1. The construction of a minimum 30 million gallon SDU.

2. Remote cameras and lighting to allow viewing of the grout discharge into the SDU and grout height level indication inside the SDU.

3. Ventilation system(s).

4. Infrastructure including electrical power connections and skids, I & C signal connections and skids, area lighting, and drainage.

5. Installation of a groundwater well(s) to allow hydrostatic testing of the SDU and future SDUs.

6. Tie-ins to existing grout transfer and drainwater return systems.

7. Installation of stair tower for emergency egress and operational accessibility.

8. Site preparation will be performed under Reference 5.5.60 and is not part of the scope of this TR&C. However, some additional excavating and drainage management may be required prior to and after construction of the SDU and is part of this TR&C scope.

9. SDU roof penetrations/access ports with shielded plugs or covers for installed equipment, vapor space sampling, ventilation, and final clean grout capping (fill/vent ports).

10. Grout temperature monitoring system.

11. Portable vapor space CLFL monitoring equipment and sampling lines.

12. Grout distribution system.

13. A drainwater system to collect and return the drainwater (flush water collected from periodic grout line flushing operations and routine bleed water collected from the grout curing process) back to SPF.

14. A leak detection system for monitoring leakage from the SDU 6 cell.

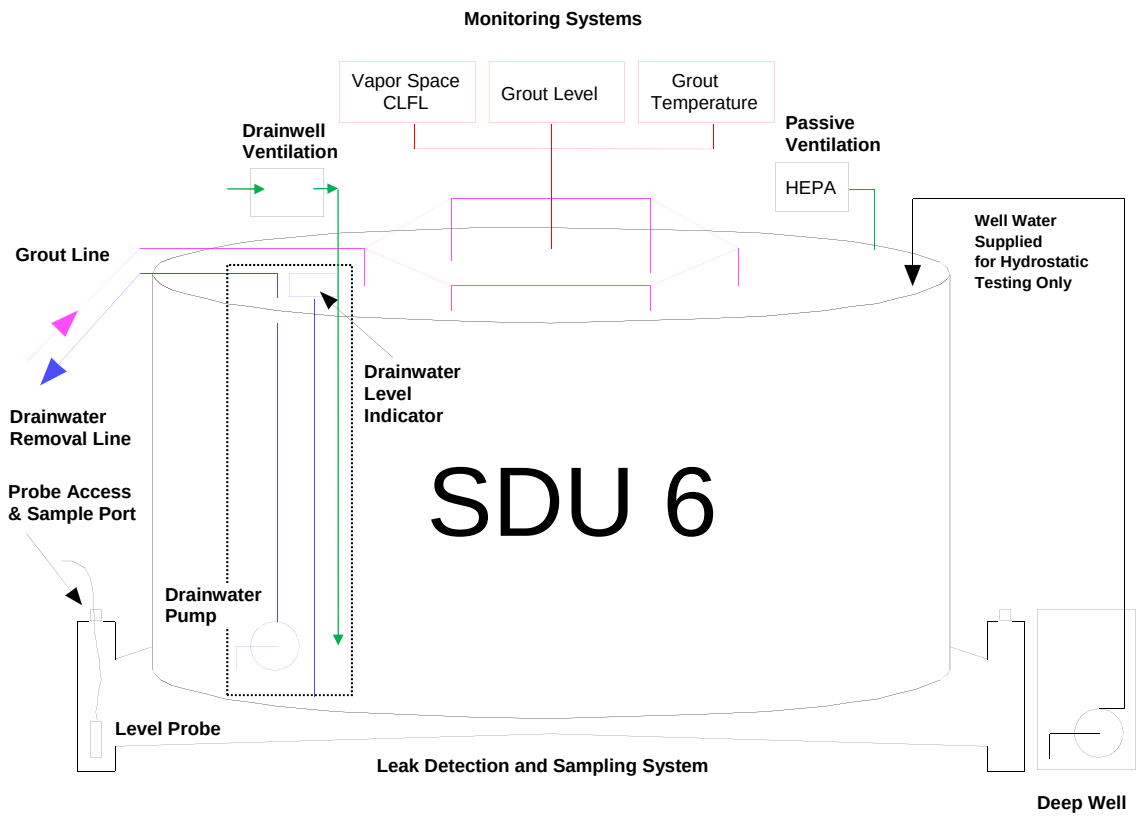

Figure 1 – Conceptual SDU Equipment Diagram

1.2.2 Basis of Modification

Modifications are required to Z-Area Saltstone Facility in order to support the Liquid Waste System Plan and to meet contract objectives.

1.2.3 Objectives of Modification

The objective of this modification is to provide a minimum 30 million gallons of additional saltstone disposal space to enable the continued processing and disposition of salt solution waste streams as identified in the Liquid Waste System Plan.

1.2.4 Plant Modification Location

All modifications will be located in Z-Area, SRS, Aiken, SC, 29808. The location of SDU 6 has been identified in the Siting of Future Saltstone Disposal Units Study (Ref. 5.5.41).

1.3 Plant Modification Boundaries and Interface Requirements

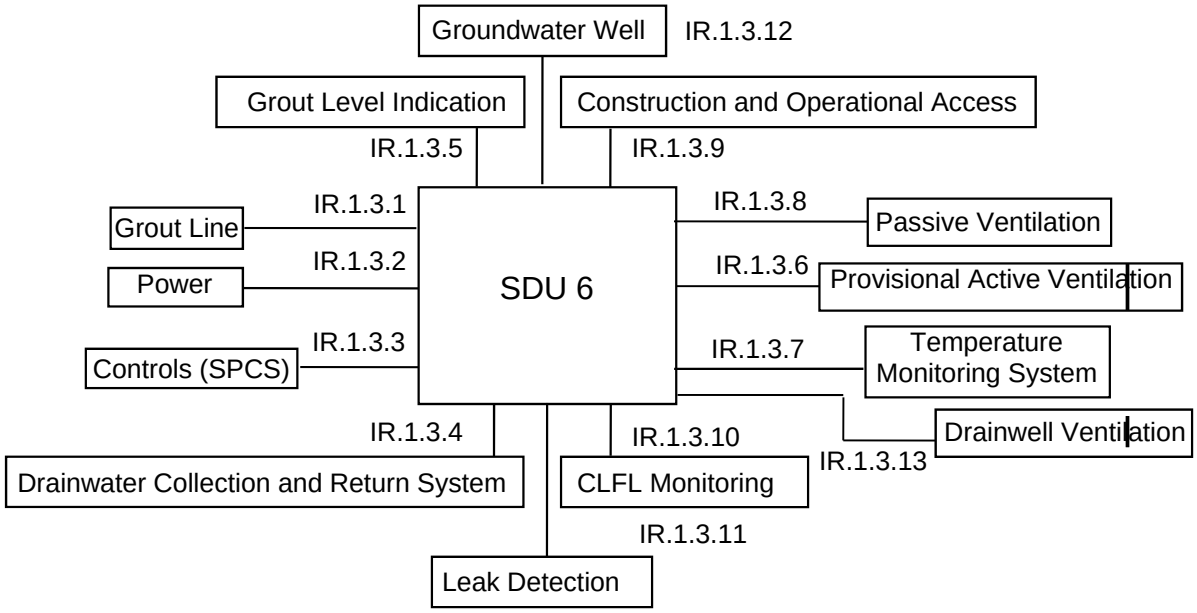

Figure 2 – System Interface Diagram

The Interface Requirements (IR) are as follows:

IR 1.3.1 Grout Line

SDU 6 shall be designed to accommodate grout line piping with nine discharge ports through the roof minimizing any potential for SDU roof contamination or releases to the environment. **NOTE:** The SDU 6 grout line will tie into an existing grout line.

Basis: Contamination control is required for protection of the workers, environment, and is consistent with ALARA principles.

IR 1.3.2 Power

SDU 6 will require power from Z-Area.

Basis: Electrical power is required to operate the SDU.

IR 1.3.3 Controls

Primary control and monitoring of SDU 6 shall be provided from the Saltstone Processing Facility 210-Z Control Room. The SDU 6 project shall provide a control system which interfaces between all applicable SDU 6 supplied instrumentation and control devices and the 210-Z Saltstone Process Control System (SPCS) using current commercial bus technologies where applicable. Controls and monitoring shall be provided for the SDU ventilation system(s), Drainwater system, selection of grout pour locations, grout temperature monitoring, and leak detection. The 210-Z SPCS is an Emerson Process Management Delta V Distributed Control System (DCS). The SDU 6 Project will not change the basic system design, but will add field components and modify software to operate the new equipment configuration.

Basis: Saltstone Processing Facility will own and operate SDU 6.

IR 1.3.4 Drainwater Collection and Return System

SDU 6 requires a drainwater collection and return system that provides a means to remove drainwater and return it to SPF for treatment.

Basis: Consent Order of Dismissal (Ref. 5.5.8)

IR 1.3.5 Grout Level Indication

Saltstone grout level indication shall be provided on the columns from the floor to 43 ft and on the wall at 41 ft.

Basis: Available capacity, CLFL determination, and differential loading determination.

IR 1.3.6 Provisional Active Ventilation

1.3.6.1 As risk mitigation, the design shall support a provisional active ventilation system being installed to remove flammable vapors from the SDU bulk vapor space.

Due to a recent change in the feed material for SDU 6 (no longer processing SWPF material) being processed through SPF, the active ventilation system that was designed is no longer required. However, in case the feed material is changed to contain a higher Isopar-L concentration and for potential use on future SDUs, the design and specification for the ventilation system is being retained as Provisional.

Basis: Ref. 5.5.55

1.3.6.2 Deleted

IR 1.3.7 Temperature Monitoring

The temperature monitoring system must interface with SDU 6. Four thermocouple trees will be installed using penetrations in the cell roof and will provide indication in the 210-Z Control Room. The temperature monitoring system will also provide alarms.

Basis: The grout temperature is monitored for grout quality and operational trending.

IR 1.3.8 Passive Ventilation

SDU 6 requires a passive ventilation system. The passive ventilation system serves multiple purposes.

- Ventilation of the SDU through atmospheric breathing (heating/cooling, expansion/contraction cycles, grout pours, pigging, clean cap).
- Air inlet pathway during operation of the provisional active ventilation system.

- Prevents the development of excessive differential pressure between the SDU and the atmosphere (See DC 3.2.1.11).
- Contamination control while pouring saltstone.

The system shall be equipped with HEPA filtration and ducting connected to the SDU.

Basis: The safety strategy requires SS passive ventilation [Ref. 5.5.45 and 5.5.66].

IR 1.3.9 Construction and Operational Access

Accessibility provision shall be provided to allow for safe construction and operational activities for the construction, operation, maintainability, and closure of SDU 6. Design features and site clearing shall include, but are not limited to the following.

- Installation of stair tower for emergency egress and operational accessibility.
- Cleared buffer area around the SDU perimeter for constructability, including construction machinery, and for operation, maintenance, and closure activities

Basis: Access for construction personnel and equipment must be provided for construction of SDU 6. Access for Operational personnel must be provided to allow safe continued operation of the SDU during operation, maintenance, and closure activities.

IR 1.3.10 CLFL Vapor Space Monitoring

SDU 6 shall include portable vapor space Composite Lower Flammability Limit (CLFL) monitoring to ensure flammability limits are not exceeded during the release of flammable organic vapors from the grout into the vapor space.

Periodic flammability monitoring shall be performed to verify the SDU 6 vapor space flammable concentration is less than or equal to the CLFL limits as prescribed per applicable NFPA codes. Periodic CLFL monitoring shall be performed using M&TE.

Basis: NFPA 69 Compliance

IR 1.3.11 Leak Detection

SDU 6 shall include a PS leak detection system. The system shall be equipped with a conductivity probe with a DCS control room alarm during operation. The system shall also include a means to sampling any collected material for analysis of potential chemical and radiological constituents.

Basis: Ref. 5.5.8

IR 1.3.12 Groundwater Well

Installation of a new PS deep groundwater well(s) in Z-Area to provide water to perform a leak tightness test of SDU 6 and any future SDUs is required. The well water system shall provide a minimum of 700 gpm.

Basis: Provides the capability to perform a hydrostatic tightness test of the SDU cell.

IR 1.3.13 Drainwell Ventilation

The drainwell ventilation shall be installed to dilute flammable vapor concentrations in each drainwell.

Basis: Ref. 5.5.81

1.4 Plant Modification Classifications

The specific design requirements and criteria based on these classifications are stated in Section 3.0.

1.4.1 Functional Classification

The highest Functional Classification of this plant modification has been determined to be Safety Significant (SS) based on the SDU 6 PCHA (Ref. 5.5.45). A listing of the Safety Related Structures, Systems and Components (SSCs) and their safety functions are provided in Table 1 below.

Unless otherwise stated, the Functional Classification of a Structure, System, or Component is PS.

The final functional classification determination will be made in accordance with SRS Procedure Manual E7, Procedure 2.25 (Functional Classifications) following completion of the Consolidated Hazard Analysis Process (CHAP).

1.4.2 Hazard Category

The hazard category for this facility is HC-2 per SDU 6 PCHA (Ref. 5.5.45) as defined by WSRC 11Q (Facility Safety Document) and DOE-STD-1027.

1.4.3 Performance Category

The Natural Phenomena Hazard (NPH) Performance objectives for this modification are based on comparisons to the current SDU performance categories identified in the current Saltstone Facility DSA (Ref. 5.5.6) and SDU 6 PCHA (Ref. 5.5.45).

NPH Performance Objectives are used to define the NPH design criteria for existing, modified, or new SSCs.

Seismic Performance Objectives

For new or modified SSCs, the seismic performance objective is defined in terms of Seismic Design Category and Limit State. DOE Standard 1189 and Manual SCD-11 defines the SDC based upon the consequence magnitude calculated during development of the CHA.

The Saltstone Facility DSA (Ref. 5.5.6) has determined that a NPH Event (Seismic or Non-Seismic) is not a credible event initiator requiring safety controls for the existing SDUs (1, 2, 3, 4, & 5). The PCHA (Ref. 5.5.45) for SDU 6 has also determined that an NPH Event is not a credible event initiator requiring safety controls for SDU 6. However, as a structure regulated by the SCDHEC, the SDU cell (walls, floor, and roof) is required to meet SDC-2 Limit State D criteria (SRS Structural Design Criteria Engineering Standard 1060, Ref. 5.5.40). The seismic design criteria for SDU 6 are provided in Table 1 below.

Unless otherwise stated, the SDC for new or modified SSCs is SDC-1, Limit State A.

Non-Seismic NPH Performance Objectives

For SSCs, non-seismic NPH performance objectives are defined in terms of Performance Category. DOE Standard 1189 and Manual SCD-11 defines the Performance Category based upon the consequence magnitude calculated during development of the CHA.

Unless otherwise stated, the non-seismic NPH Performance Objective for SSCs is PC-1.

Table 1, SSCs Functional Class and Performance Category [Ref. 5.5.45]

SSC Description	Funct. Class.	SDC	Limit State	End Condition	Non-Seismic NPH	NPH Performance Objective and Safety Function
Disposal Unit Walls, Floor and Roof	PS	SDC-2	D	PR, PB	PC-1	• Essentially elastic behavior, gaseous, particulate, and liquid confinement is maintained. • SSC must be capable of performing all above safety functions: Before, during, and following a Seismic event.
Passive Vents NOTE: HEPA filters are PS and HEPA housing is SS	SS	SDC-1	A	PR	PC-1	• Provide a flow path between the SDU cell vapor space and atmosphere in order to minimize the potential for reaching CLFL conditions inside an SDU by allowing air displaced by the grout being poured to exit the cell and allowing passive breathing of the cell (radiological and chemical events). • Provides the pathway for the air that is used to purge the cell vapor space during the operation of the disposal cell provisional ventilation system (radiological and chemical events).

1.5 Technical Issues, Assumptions, and Opportunities [Ref. 5.5.55 and 5.5.57]

1.5.1 Technical Issues

1.5.1.1 Thermal Transient Calculation – Grout heat of hydration can result in temperatures above the 95°C limit (Ref. 5.5.6) if fill rate, geometry, and thermal characteristics of the SDU 6 are unfavorable.

Position Taken – A heat of hydration calculation will be performed as part of the SDU 6 project.

Resolution – Calculation complete [Ref. 5.5.71]. A solar reflective roof coating and exterior wall insulation will be applied to SDU 6.

Impact – None. Based on the calculation, this issue is closed.

1.5.1.2 Grout Flowability – Grout must reach sides of the SDU from stationary pour location(s). In addition, if the grout is allowed to flow greater distances in a larger SDU, the potential exists for stratification of the grout mixture, producing a lower quality saltstone.

Position Taken – Based on operating experience with Vaults 1 and 4, grout will flow at least 75 feet (lateral distance) before setting up. Multiple pour locations will be installed as necessary to reach the sides and not to create interior void space.

Resolution – Testing (Ref. 5.5.80) has concluded that long-radius pours do not produce low quality grout. During testing, the grout with the most saltstone representative yield stress flowed 95 ft. The bleed water ran clear and did not produce any low quality grout by transporting material or by recombining with the perimeter grout. Pour location(s) will be selected to maintain a pour radius of no more than 80 feet.

Impact – None. Based on testing, this issue is closed.

1.5.1.3 Ventilation Requirements During Pig Launches – Adequate ventilation must be provided to safely handle projected SDU radioactive emissions and displaced air during processing.

Position Taken –SDU provisional active ventilation will not be required during pig launches. The passive ventilation system with HEPA filtration will be adequate.

Resolution – HEPA units installed on Vault 4 eliminate the need for forced ventilation during pig launches per LWO-WSE-2008-00113, Rev. 1. SDU 6 will add HEPA filtration units on passive vents similar to those used at SDU 2 & Vault 4. With the larger vapor space in SDU 6, no additional operational or design features are anticipated.

Impact – None. Based on the SDU 6 large vapor space volume and the installation of HEPA filters, this issue is closed.

1.5.1.4 Drainwater System Pluggage – Insoluble solids have the potential for collecting in shallow parts of the drainwater system creating pluggage. (Ref. 5.5.25)

Position Taken – Drainwater system shall be designed to reduce or eliminate the risk of system pluggage.

Resolution – Drainwater system shall have design features to prevent or address pluggage. A 10 micron filter fabric is being installed at Drainwater system entry locations and flush water connections are being provided. [Ref. 5.5.86]

Impact – None. Based on the recent successful performance of SDU 2 Drainwater collection system with the 10 micron fabric, this issue is closed.

1.5.1.5 Well-mixed vapor space – All of the flammable gas concentration models assume that the vapor space of the cell remains well-mixed such that a stratified layer of flammable gas will not form. No modeling has been performed for SDU 6. Whether a larger SDU vapor space remains well-mixed will have to be evaluated.

Position Taken – The larger SDU vapor space will be modeled.

Resolution – Additional studies evaluating the effects of diffusion and thermal mixing in a larger SDU shall be conducted to determine the vapor space flammability.

Impact – None. Mixing has been demonstrated through CFD modeling [Ref. 5.5.87] and vapor space flammability analysis [Ref. 5.5.84]. This issue is closed.

1.5.1.6 Scale-up issues – All of the Isopar-L release data obtained from SRNL was based upon organic vapor release from 250 mL samples of grout. In the case of SDU 6 with anticipated size of 375 ft. diameter x 43 ft. in height, the release rate may be significantly different.

Position Taken – The SRNL data consistently showed that the fraction of Isopar-L released from the grout samples was directly proportional to the vapor pressure, regardless of the initial Isopar-L concentration. The current analysis based on SRNL data does not include any time for flammable vapors to diffuse through the grout. As shown in Appendix C of Ref. 5.5.84, accounting for the diffusion of flammable vapors through grout would significantly reduce the calculated CLFL.

Resolution – Perform flammability analysis for SDU 6 [Ref. 5.5.84].

Impact – Provisional ventilation system may be required. If SWPF material [Ref. 5.5.49] with Isopar L concentration greater than 11 ppm is processed through SPF and intended for SDU 6, then the provisional active ventilation system may be required to be installed. Re-evaluation of flammability based on expected maximum Isopar L concentration would be required. Based on the above, this issue is closed.

1.5.1.7 Stack Emissions - The stack release for the provisional active ventilation system must meet the requirements for occupational exposure.

Position Taken – For the smaller SDUs, an air dispersion model was performed for key constituents such as Benzene, Dimethyl Mercury, and Trimethyl Amines in order to determine operational impacts on the ground and on the roof of the cell [Ref. 5.5.29]. A new model will be performed for the larger SDU provisional active ventilation system.

Resolution – By dispersion modeling, results have determined that the stack height and position of the provisional active ventilation system are such that the limits for occupational exposure are not exceeded [Ref. 5.5.85].

Impact – None. Based on completion of dispersion modeling [Ref. 5.5.85], the design and location of the provisional ventilation system adequately protects personnel. This issue is closed.

1.5.1.8 **Hydraulic Requirements -** The hydraulic requirements for transferring grout to SDU 6 have been evaluated for a steady state flow condition; however, the system must be evaluated for pressure pulsations to account for the pulsations created by the peristaltic grout pump and mitigated by the pulsation dampeners.

Position Taken – A pulsation hydraulic calculation will be performed to ensure that the grout pump and piping are capable of achieving the desired performance for transferring grout to SDU 6.

Resolution – A preliminary calculation has been performed by the design agency that concludes the existing grout pump is capable of pumping to SDU 6 without any modifications [Ref. 5.5.95].

Impact – Modify the existing grout pumping system or implement other options identified in the SEE.
This issue will be closed upon approval of hydraulic calculation concurrent with final design approval.

1.5.1.9 **Grout Quality** - Due to the larger size of SDU 6, the potential exists for smaller grout lifts in SDU 6 than for the smaller SDUs. Thinner grout formation layers could impact the amount of oxygen exposure to the grout producing more soluble technetium, which could be release more readily from the SDU to the environment. Thinner lifts may also result in a loss of other important grout properties assumed in the PA.

Position Taken – Perform testing to verify saltstone quality is not compromised as a result of thin grout pours due to a larger SDU diameter.

Resolution – Testing (Ref. 5.5.75) has concluded that thinner lifts do not reduce the compressive strength of the grout, do not change porosity, and do not significantly impact hydraulic conductivity. Testing showed no obvious

impact on the Leachability Index and elevated (1000 mg/L) Chromium, used as a Technetium surrogate, was below detectable levels. This shows that there is no significant oxidation occurring, which will produce soluble Chromium above the minimum detectable level (< 0.100 mg/L).

Impact – None. Based on testing, this issue is closed.

1.5.1.10 Grout Drop Height - As a result of the larger sized SDU the maximum drop height of the grout will be increased from 23 ft. to an anticipated 43 ft. With the increase in drop height, the potential exists for separation of the grout mixture that could result in a loss of important grout properties assumed in the PA.

Position Taken – Testing will be performed to ensure grout quality is not compromised at a drop height of 43 ft. or the grout will be placed at a lower acceptable height.

Resolution – Completed Computation Fluid Dynamics (CFD) modeling for a drop height of 43 ft. Modeling concluded for drop heights of 5 ft. and 43 ft., the spread of grout (radial flow) and the grout to air volume fractions were essentially the same for pour durations greater than 30 minutes with a grout flow rate of 150 gpm [Ref. 5.5.77].

Impact – None. Based on CFD modeling, this issue is closed.

1.5.2 Assumptions

1.5.2.1 Environmental Compliance Authority (ECA) shall obtain approval to operate SDU 6 in a timely fashion.

- **Position Taken –** SCDHEC will provide approval to operate.
- **Resolution –** ECA shall prepare submittals and obtain approval.
- **Impact –** Project cannot start construction or operation until approval to operate is granted.

1.5.2.2 The existing approved Performance Assessment (PA) does not include the larger (minimum 30 million gallons) cylindrical SDU design (Ref. 5.5.16).

- **Position Taken –** The Closure and Waste Disposal Authority shall prepare and submit a revised PA or

Special Analysis (SA) in a timely fashion for DOE approval.

- **Resolution –** The Closure and Waste Disposal Authority will issue an SRR approved PA or SA that addresses the larger SDU configuration to DOE for approval to implement.

- **Impact –** Saltstone Facility will not begin operation in SDU 6 until the revised PA or SA is approved.

1.5.2.3 SDU 2, 3, and 5 cells are open and receiving grout while SDU 6 is under construction.

- **Position Taken –** The current plan will require the use of multiple SDU cells at one time to manage grout temperature increases from the heat of hydration.

- **Resolution –** This assumption is identified to protect workers during the construction of SDU 6. No change will be required even if the plan changes.

- **Impact –** None

Note: Assume SDU 3&5 utilities and infrastructure will be in place to support tie-ins for SDU 6.

1.5.2.4 Deleted.

1.5.2.5 Deleted.

1.5.2.6 Deleted.

1.5.2.7 Deleted.

1.5.3 Opportunities

1.5.3.1 Deleted

1.5.3.2 Removal of Internal Tank Membrane Coating

- **Position Taken –** Internal membrane coating is required in accordance with ACI-350 based on structure exposed to sulfate. Until exposed sulfate levels are evaluated, internal coating will be assumed required and will be included as an option in the SDU Structure RFP.

- **Resolution –** Evaluate SDU sulfate exposure levels and determine if internal coating is required.

- **Impact –** None, the internal coating is already in the current design as an optional installation.

1.6 Studies and Evaluations

1.6.1 Rectangular Vaults (SDUs)

Vault 1 and Vault 4 were constructed between 1986 and 1988. These vaults are a rectangular design with a 2% slope from the center roof line. The vaults are constructed with reinforced cast-in-place concrete. Vault 1 is approximately 600 ft. long, 100 ft. wide, 27 ft. high, and contains six 100 ft. by 100 ft. cells. Vault 4 is approximately 600 ft. long, 200 ft. wide, 30 ft. high, and contains twelve 100 ft. by 100 ft. cells. Saltstone Facility operation commenced with the production of saltstone grout in 1990.

In March 2003, a Value Engineering Study was conducted as a future vault (new vaults) construction cost savings effort [Ref. 5.5.46]. This study considered different configurations (cell arrangements) and the use of different material of construction (concrete, mechanically stabilized earth, clay materials, and flexible membrane liners). The study concluded that construction with pre-cast concrete walls/panels is significantly less expensive than cast-in-place concrete. The recommendation of this study was to build a hybrid design which included the use of pre-cast concrete walls, mechanically stabilized earth (reinforced soil), and liners to reduce the construction cost of the current vault design (Vault 1 and 4).

1.6.2 Cylindrical SDU Design

In January 2005, another Value Engineering Study was performed [Ref. 5.5.52]. The goal of this study was to determine the best SDU design based on cost, schedule, technical issues, and operational factors for the construction of SDU 2. This study considered several designs as follows.

- Option 1: 3 Cell Vault: similar to the Vault 1 design (prism with sloped roof)
- Option 2: Arch Vault: pre-cast arch building supplied by vendor in the shape of a Quonset hut.
- Option 3: Cylindrical Vault: AWWA water storage tank

- Option 4: Trench Vault: cast-in-place concrete floor and walls (long walls slope outward towards the top), and a pre-cast roof (prism with sloped walls)
- Option 5: Mechanically Stabilized Earth: recommend hybrid design from previous VES (prism with sloped roof)

Option 2, 4, and 5 were eliminated by the "Go/No-Go" Screening Evaluation. Options 1 and 3 were graded on Cost/Schedule (30 points), Technical Issues (40 points), and Throughput (30 points). Option 3, Cylindrical Vault, score higher in all three categories and was recommended for the construction of SDU 2. SDU 2 was constructed using this vault design and SDU 3 and 5 are under construction using the same design. These SDUs are an AWWA D110 Type III tank design. The design is constructed using a cast-in-place floor slab and roof slab with pre-cast wall panels. The wall panels are cast on the ground and raised into place along the edge of the floor slab. The gaps between the wall panels are later closed by cast concrete and epoxy resin. These SDUs are 150 ft. in diameter and 22 ft. high with a capacity of 2.6 million gallons.

1.6.3 "Mega-Tank" Design

The construction cost of the Saltstone Disposal Facility SDUs was identified as being a significant portion of the Liquid Waste life cycle cost. An SRR initiative was created to evaluate options/strategies to reduce the cost and complexity of the low level radioactive waste decontaminated salt solution disposal process. In September 2011, as a short-term initiative a Value Engineering Study (VES) [Ref. 5.5.36] was completed to reduce cost using the current disposal strategy (saltstone SDUs). The VES concluded that significant cost saving could be achieved by building larger SDUs on a cost per gallon basis. SDU 6 will be the first large SDU constructed as a result of the VES.

This VES also included others ways to reduce cost and complexity by removing design features currently incorporated into the current SDU designs (SDU 2, 3, and 5). The other costs saving/reduced complexity ideas are listed below:

1) removal of exterior curb design
2) removal of Geonet
3) change the thickness of the upper mud mat
4) change the cement in the concrete from Type V to Type II
5) removal of exterior roof coating
6) use an alternative material for Drainwater system piping

1.6.4 Size Optimization

The “mega-tank” VES did not perform a size optimization for the construction of larger SDUs. The basis for the size optimization was performed during the size selection of SDU 6 [Ref. 5.5.53].

The tank dimensions were validated to be optimal on a price per gallon basis by using several cost estimates with different tank dimensions.

1.6.5 Related Work

As a long-term SRR initiative to evaluate options/strategies to reduce the cost and complexity of the low level radioactive waste decontaminated salt solution disposal process, a System Engineering Evaluation (SEE) [Ref. 5.5.58] was performed to identify different options/strategies for the disposal of low level decontaminated salt solution. As a result of the SEE, several options were recommended for further viability assessment. Listed below are the options/strategies recommended for further assessment by the SEE.

1) Concentration of decontaminated salt solution waste with a wiped film evaporator prior to sending to the saltstone process: Since the decontamination factor for cesium is sufficient during the separation of the low level salt solution (ARP/MCU), the waste can be concentrated prior to sending to the saltstone process. If the waste is concentrated via an evaporator, organics in the waste could also be destroyed reducing or eliminating flammability controls for the SDUs.

2) Fill watertight containers with saltstone and dispose in engineered trenches at the Saltstone Disposal Facility: Watertight Sealand containers could be filled with saltstone and permanently installed in an engineered landfill trench.

3) Fill cleaned, removed-from-service, waste tanks with saltstone: Instead of using clean grout to close waste tanks use saltstone grout, thereby reducing the radiological foot print of the site.

4) Disposal of decontaminated salt solution off-site: Transport the decontaminated salt solution to an off-site facility to produce a grout and then transport the cured grout container to a permanent off-site disposal facility.

This work is on-going and independent of the SDU 6 Project.

2.0 FUNCTIONS AND PERFORMANCE REQUIREMENTS

This section provides functions, performance requirements, and the basis for each requirement. Functions are identified by an “F” before the number. Performance Requirements are identified by a “PR” before the number.

2.1 Upper Level Functions

The upper level system functions are as follows:

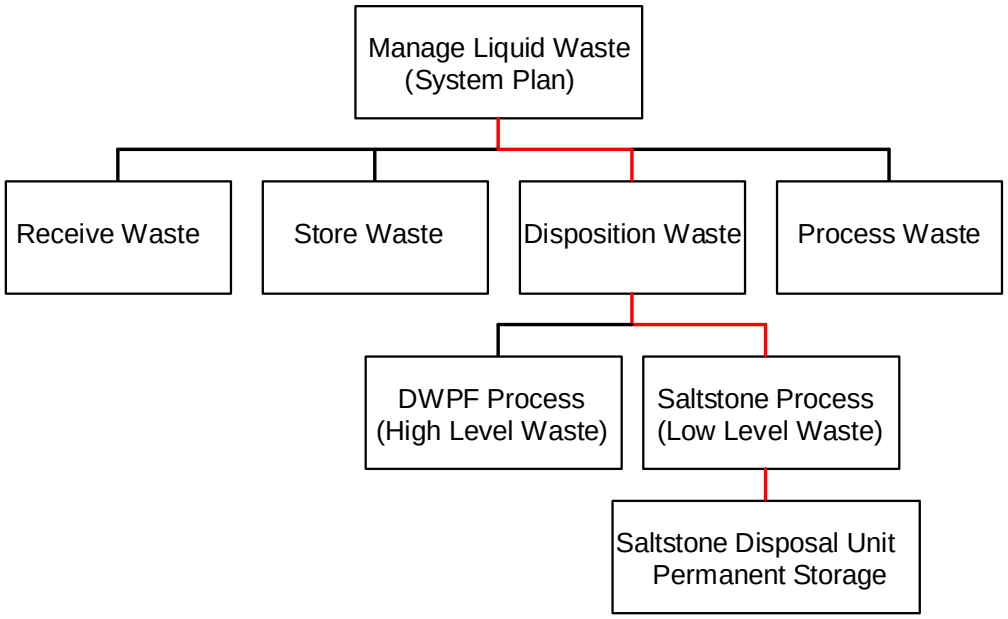

Figure 3 – Upper Level System Functions

2.2 Plant Modification Functions and Performance Requirements

The primary Function of the Saltstone Disposal Units is to provide a safe, long-term, permanent disposal location for the disposed saltstone. The SDU upper level functions are as follows:

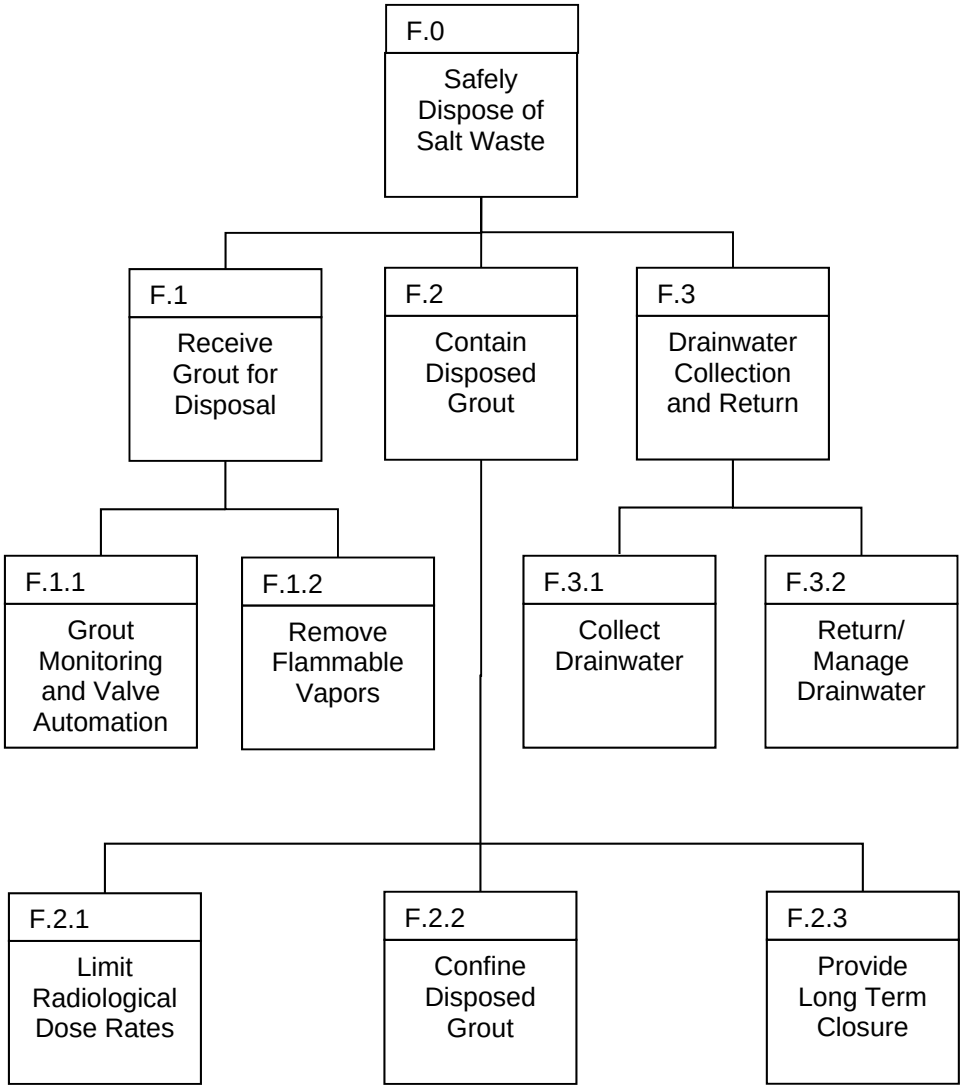

Figure 4 – SDU Functional Hierarchy Diagram

Function F.1 – **Receive Grout for Disposal**

Table 2

Function F1.1 – Grout Monitoring and Valve Automation

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.1.1	PS	Cameras	Cameras with lighting shall be provided to allow general SDU 6 interior viewing with overlapping coverage. If camera lighting cannot achieve sufficient lighting, a less preferred method is to use sacrificial lights mounted in the SDU interior. Cameras shall be compatible with existing display monitors in the 210-Z Control Room (unless new monitors are provided).	Protection of the environment and safe operation requires monitoring grout fill level for CLFL control. [Ref. 5.5.6 and 5.5.45]
PR.1.1.2	PS	Cameras	Each installed camera location shall have an identified spare backup penetration for the installation of a new and/or temporary camera capable of viewing grout level indicator.	Allows replacement of camera without loss of camera operability.

Table 2

Function F1.1 – Grout Monitoring and Valve Automation

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.1.3	PS	Cameras	Cameras shall be installed through the roof and extended down as minimal a distance as practical, but no more than the saltstone fill height of 41 feet from the bottom of the SDU interior wall.	Effective utilization of SDU space based on SDU camera design. The SDU cannot be filled higher than camera level until final closure.
PR.1.1.4	PS	Cameras	Cameras shall be remotely selectable from the 210-Z Control Room. Lights shall be controllable (On/Off) from the control room. Interior sacrificial lights (not preferred) may be operated from a remote switch.	Avoid personnel exposure associated with selecting camera or operating lights at the SDU.

Table 2

Function F1.1 – Grout Monitoring and Valve Automation

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.1.5	PS	Grout Level Indicators	Grout level indicators shall be provided in SDU 6. Indicators are to be positioned on the columns and the SDU interior wall. The column indicators shall be located as close to the pour locations as practicable for viewing with cameras. Column level indicators shall be demarcated from the starting elevation to 43 ft. in no greater than 3 inch discernible increments. The wall level indication shall be provided by a single band at an elevation of 41 ft. Column indicators shall be outside the splash zone of the grout. A minimum of one column indicator for each pour location shall be provided. The actual height measurement shall be from the floor elevation at the SDU interior wall to the top of the indicating mark width (i.e., if the mark is visible the indicated height has not been reached). With a sloped floor, the interior columns will not start at 0 ft., since the level is referenced to the floor elevation at the wall. Indicators shall have a white background and black letters and must be discernible by at least one camera. The markings for a grout level of 41 ft. must be easily distinguishable.	Protection of the environment and safe operation requires monitoring grout fill level for CLFL control. [Ref. 5.5.6 and 5.5.45]. Also protects PA fill limit for clean capping. The grout fill limit is 41 ft. to allow for a 2 ft. cap of clean grout [Ref. 5.5.16].

Table 2

Function F1.1 – Grout Monitoring and Valve Automation

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.1.6	PS	Grout Piping Components	Grout pouring distribution arrangement shall be such that full tank coverage is provided assuming an 80 ft. grout flow radius from each pour location.	Section 1.5.1.2
PR.1.1.7	PS	Grout Piping Components	The grout line and SDU 6 grout distribution system shall be designed for a nominal grout flow rate of 150 gpm. The grout line must also support line flushes and pig launches. Note: The continuous duty rating of the current grout pump is 232 psig [Ref. 5.5.96]. The rupture pin is set at 292 psig.	Input Data and Assumption for Saltstone Facility [Ref. 5.5.34]
PR.1.1.8	PS	Grout Piping Components	The SDU 6 grout line shall be connected to an existing line via a 3-way piggable valve.	Proper system tie-in for operation.
PR.1.1.9	PS	Grout Piping Components	Piggable grout distribution shall be provided to allow switching between SDU 6 grout pour locations.	SDU 6 will require multiple pour locations.

Table 2

Function F1.1 – Grout Monitoring and Valve Automation

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.1.10	PS	Grout Piping Components	Grout line valving shall allow remote control through the DCS and local hand manipulation. Valves shall be equipped with DCS position indication.	Local control required in case of DCS/Mechanical failure. Remote automation required to minimize personnel resources and exposure. Position indicators required per Reference 5.5.45.
PR.1.1.11	PS	Thermocouples	The temperature monitoring system for SDU 6 shall be composed of four (4) thermocouple (T/C) trees. The trees shall be evenly distributed to provide temperature monitoring coverage for each pour location and shall be capable of measuring the temperature of the surrounding grout.	Maintains historical records for documenting curing conditions related to grout quality.
PR.1.1.12 (Deleted)				

Table 2

Function F1.1 – Grout Monitoring and Valve Automation

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.1.13	PS	Temperature Indicators	Temperature measurements from the thermocouples will be provided to the Operators in the 210-Z Control Room via the DCS. The temperature transmitters shall provide temperature readings with a minimum range of -10°C to +110°C. The ability to trend the SDU temperature indicators shall also be provided.	Provide trend data for process understanding and troubleshooting.
PR.1.1.14	PS	Thermocouples	Temperature instrumentation will provide temperature indication from the floor (6 inches) to a height of 42.5 ft., with thermocouples located every 12 inches along the length of the tree.	Temperature must be monitored at multiple heights due to grout level changes.
PR.1.1.15 (Deleted)				
PR.1.1.16 (Deleted)				

Table 2

Function F1.1 – Grout Monitoring and Valve Automation

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.1.17 (Deleted)				
PR.1.1.18 (Deleted)				
PR.1.1.19	PS	SDU	SDU 6 shall have a grout receipt availability of 90%. The availability includes downtime for operability failures, and preventive and corrective maintenance activities.	To meet the Liquid Waste System Plan objectives [Ref. 5.5.62].
PR.1.1.20	PS	Cameras	Cameras shall be located such that an Operator can clearly determine the grout height.	Saltstone DSA [Ref. 5.5.6]

Table 3

Function F1.2 – Remove Flammable Vapors

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.2.1	SS	Provisional Active Ventilation	SDU 6 Provisional ventilation system shall provide a minimum flow rate of 2,000 scfm.	Preliminary Flammability Calculation (Ref. 5.5.48)
PR.1.2.2	SS	Passive Ventilation	Provide passive ventilation with PS HEPA filtration with no means of isolation.	SDU 6 PCHA (Ref. 5.5.45)
PR.1.2.3	SS	Provisional Active Ventilation	For the provisional active ventilation system, provide design for a moisture separator unit with drain and air heater prior to the pre-filter. The heater shall be provided with an interlock that prevents heater operation without the fan being energized.	ALARA principles
PR.1.2.4	SS	Provisional Active Ventilation	Provide design for ventilation flow indication and low flow alarm with capability to be monitored from the Saltstone DCS.	Risk-053 Mitigation, [Ref. 5.5.55]
PR.1.2.5	SS	Provisional Active Ventilation	Provide design for exhaust HEPA filter differential pressure indication from the provisional active ventilation system that interfaces with the Saltstone DCS.	Fan status and environmental HEPA monitoring.

Table 3

Function F1.2 – Remove Flammable Vapors

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.2.6	SS	Provisional Active & Passive Ventilation	The ducting, including elbows, shall allow for cell vapor space air removal while minimizing short circuits between the inlet ports (passive vents).	Ensure proper ventilation of SDU [Ref. 5.5.58].
PR.1.2.7 (Deleted)				
PR.1.2.8 (Deleted)				
PR.1.2.9 (Deleted)				
PR.1.2.10 (Deleted)				

Table 3

Function F1.2 – Remove Flammable Vapors

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.2.11	PS	SDU Portable CLFL Monitor	Provide a portable handheld monitor (backup portable monitor (s) shall be provided) capable of determining the SDU vapor space flammable concentration for Isopar L. Preferential consideration shall be given to monitors that also measure other flammables (e.g., hydrogen) in addition to Isopar L. Although Isopar L is the predominant constituent of interest, measuring other flammables is also important, but not anticipated to be required.	NFPA 69 Compliance
PR.1.2.12	PS	SDU Portable CLFL Monitor	Provide two SDU 6 vapor space sampling locations. One sample location will be designated and identified as the primary, and the other will be designated and identified as the alternate. Elevation of vapor space sample line inlet shall be ~ 1 ft. above the final saltstone fill volume of 41 ft.	Ensures sample locations are positioned as low as possible for obtaining sample.

Table 3

Function F1.2 – Remove Flammable Vapors

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.1.2.13	PS	SDU Portable CLFL Monitor	Sample line shall be minimum 3/8" dia. and shall be designed to prevent accumulation of condensate. An isolation valve and 1/4" quick connect with protection plug shall be provided for connecting the portable CLFL Gas Monitor.	Ensures sample taps have appropriate connection size and valve for tank atmosphere isolation.
PR.1.2.14	PS	SDU Portable CLFL Monitor	Sample line shall include in-line gas sample filter in order to prevent potential contamination of portable CLFL Gas Monitor.	Prevent contamination of M&TE.
PR.1.2.15	PS	Drainwell Ventilation	Provide design features to prevent accumulation of flammable vapors greater than 25% CLFL in the Drainwater Collection System.	NFPA 69 Compliance
PR.1.2.16	PS	Drainwell Ventilation	Drainwell ventilation shall provide outside air to displace flammable vapors in each drainwell. The drainwell ventilation system shall provide a minimum flow rate of 10 scfh discharged near bottom of drainwell [Ref. 5.5.81].	Ref. 5.5.81 and NFPA 69 Compliance

Function F.2 – **Contain Disposed Grout**

Table 4

Function F2.1 – Limit Radiological Dose Rates

<table>
<tr><th>Performance Requirement Number</th><th>Functional Classification</th><th>Allocated to SSC</th><th>Performance Requirement Description</th><th>Basis</th></tr>
<tr><td>PR.2.1.1</td><td>PS</td><td>SDU</td><td>Provide shielding and distance from SDU 6 such that Radiation Zoning Criterion 4 (below) is not exceeded: This includes roof top penetrations/access ports/covers.
<table>
<tr><th>Zone</th><th>Design Basis Maximum Area Radiation Dose Rate (mrem per hour)</th><th>Description</th></tr>
<tr><td>1</td><td>D ≤ 0.05 (@ 30 cm)</td><td>Non-Radworker Continuous Occupancy</td></tr>
<tr><td>2</td><td>0.05 < D ≤ 0.5 (@ 30 cm)</td><td>Radworker Continuous Occupancy</td></tr>
<tr><td>3</td><td>0.5 < D ≤ 5.0 (@ 30 cm)</td><td>Intermittent Occupancy Radiological Buffer Area (RBA)</td></tr>
<tr><td>4</td><td>5.0 < D ≤ 100 (@ 30 cm)</td><td>Radiation Area (RA)</td></tr>
<tr><td>5</td><td>D > 100 (@ 30 cm) and D < 500,000 mRad/hr (@ 100 cm)</td><td>High Radiation Area (HRA)</td></tr>
<tr><td>6</td><td>D > 500,000 mRad/hr (@ 100 cm)</td><td>Very High Radiation Area (VHRA)</td></tr>
</table></td><td>WSRC Engineering Standards Manual, WSRC-TM-95-1, Standard No. 01064, “Radiological Design Standards”. See SDU 6 Dose Rates and Bulk Shielding Evaluation [Ref. 5.5.65]</td></tr>
<tr><td>PR.2.1.2</td><td>PS</td><td>Provisional Active & Passive Ventilation</td><td>HEPA filters will be installed on the passive vents and provisional active ventilation to prevent release of material to the atmosphere. HEPA filters shall be equipped with d/p indicators and aerosol challenge test connections.</td><td>ALARA principles</td></tr>
<tr><td>PR.2.1.3 (Deleted)</td><td></td><td></td><td></td><td></td></tr>
</table>

Table 4

Function F2.1 – Limit Radiological Dose Rates

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.2.1.4	PS	HDPE Geomembrane	Shielding for SDU 6 shall be such that the total dose to the HDPE geomembrane is less than 2.6 MRad accounting for radioactive decay.	Ref. 5.5.5 and 5.5.65

Table 5

Function F2.2 – Confine Disposed Grout

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.2.2.1	PS	SDU	Provide a roof to prevent rain infiltration and exposure to the elements including penetrations into the SDU (ie. rain covers on passive vent).	Grout shall be protected from the elements (Ref. 5.5.16 and 5.5.8).

Table 5

Function F2.2 – Confine Disposed Grout

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.2.2.2	PS	SDU	Provide a watertight reinforced concrete SDU structure having a minimum saltstone disposal capacity of 30 million gallons. Roof penetrations shall be sealed in a manner to prevent rain infiltration. The structure will not rely on coatings or linings to achieve water tightness. Hydrostatic testing of the saltstone fill height of 41 ft. is required. Water tightness acceptance criteria shall meet the follow three conditions (a –c): a. No measurable loss. b. Observation of traces of dye at any location exterior to the tank will constitute failure of the test and indicate that leakage exists. c. Final liquid tightness test acceptance will be the responsibility of SRR based upon field inspections and clear and objective evidence provided by the Subcontractor and accepted by SRR. Final acceptance includes SRR participation as a witness to the tank hydrostatic tightness test.	PA modeling [Ref. 5.5.16], SCDHEC Landfill permitting [Ref. 5.5.18], and Consent Order of Dismissal [Ref. 5.5.8].

Table 5

Function F2.2 – Confine Disposed Grout

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.2.2.3	PS	SDU	SDU 6 shall include a leak detection system. The system shall collect any leakage from beneath the concrete floor, if any. The system will also provide a means of sampling and removing the collected liquid. The system will utilize a conductivity probe connected to the DCS providing an alarm in the 210-Z Control Room.	Good Engineering practice and Consent Order of Dismissal [Ref. 5.5.8].
PR.2.2.4	PS	SDU	The SDU shall be designed to accommodate a differential saltstone loading level of 40 inches.	150 gpm at one pour location for one week with a flow diameter of 150 ft.
PR.2.2.5 (Deleted)				
PR.2.2.6	PS	SDU	SDU 6 shall have a low solar absorptivity coating (0.1 solar absorptivity) applied to the roof exterior to minimize thermal stresses and to allow for an increase in operational flexibility associated with elevated grout temperatures due to the heat of hydration. Tank top surface walkways and other tank top surface areas accessible to personnel shall not pose a slipping hazard.	Protects SDU roof from thermal stresses and decrease SDU interior temperature.

Table 5

Function F2.2 – Confine Disposed Grout

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.2.2.7	PS	SDU	Provide a composite hydraulic barrier made up of GCL and HDPE liners above the subgrade and below the upper mud mat for the SDU. See Section 4.3 for additional details.	Consent Order of Dismissal (Ref. 5.5.8)
PR.2.2.8	PS	SDU	Provide internal protective coating as required for sulfate attack per ACI-350. Coating shall have an associated elasticity to accommodate any potential expansion and contraction of the SDU structure to retain all protective properties that the coating provides.	ACI-350
PR.2.2.9	PS	Groundwater Well	Install a groundwater well(s) and well water supply system in Z-Area capable of delivering a minimum flow rate of 700 gpm into SDU 6 and future SDUs for hydrostatic tightness testing.	ACI-350.1

Table 6

Function F2.3 – Provide Long-Term Closure

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.2.3.1	PS	SDU	Capability shall be provided for filling the void space on top of the saltstone in SDU 6 with clean grout. At a minimum one (1) three inch diameter penetration shall be evenly spaced and provided for every 4,418 sq. ft. of roof surface area which equates to an area 75 ft. in diameter.	Z-Area Industrial Solid Waste Landfill Permit (ISWLF) # 025500-1603, 4/2/86, Section G [Ref. 5.5.18].
PR.2.3.2 (Deleted)				
PR.2.3.3	PS	SDU	Internal components installed in SDU 6 shall be removed or allowances shall be made for adequate access to ensure that once SDU 6 is filled and capped, any void space can be filled with clean grout or other cementitious closure material.	Void spaces shall be filled prior to closure [Ref. 5.5.16].

Table 6

Function F2.3 – Provide Long-Term Closure

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.2.3.4	SS	Passive Ventilation	Passive Ventilation system shall be maintainable for continual vapor space purging through atmospheric breathing to prevent the vapor space from reaching 25% CLFL, after saltstone grout filling operation has discontinued and prior to filling entire vapor space with clean grout. Anticipated to be no more than 25 years. [Ref. 5.5.56]	SDU 6 PCHA [Ref. 5.5.45],Flammability Calculation [Ref. 5.5.84], and NFPA 69 Compliance

Function F.3 – **Drainwater Collection and Return**

Table 7

Function F3.1 – Collect Drainwater

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.3.1.1	PS	Drainwater Collection Piping	Collection system shall allow for collection of drainwater from the grout surface of the SDU. Level indication for the drainwater collection system shall be provided with local indication and remote reading on the DCS in the 210-Z Control Room.	Consent Order of Dismissal [Ref. 5.5.8].
PR.3.1.2	PS	Drainwater Vents (if necessary)	The Drainwater collection system shall be vented.	The Drainwater system must be vented to relieve pressure in the piping system in order to allow the flow of drainwater. The vented system will also serve to promote the flow of grout during the closure process [Ref. 5.5.16].
PR.3.1.3 (Deleted)				
PR.3.1.4	PS	Drainwater Collection System	Drainwater Collection System shall prevent particles greater than 10 micron from entering the Drainwater Collection System and Drainwater Return System.	Reference 5.5.54.

Table 8

Function F3.2 – Return/Manage Drainwater

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.3.2.1	PS	Drainwater Piping and Valves	Design shall accommodate periodic transfers to the SFT via the drainwater return system. The drainwater return system shall be discharged from the top of the SDU and shall not penetrate the SDU wall or floor.	System is required to provide a means of removing drainwater and returning it to SPF for treatment.
PR.3.2.2	PS	Drainwater Pump	Drainwater Return System shall provide a nominal flow rate of 40 gpm with local and DCS indication. Drainwater pumps shall be centrifugal type. Multiple (more than two) Drainwater Return System pumps shall be provided.	Provides a medium flow range. Too large of a flow rate could cause excessive cycling of the pump and will reduce the required reaction time during transfers to the SFT. Too small of a flow rate may not keep up with production and will increase the duration of operational monitoring and constraints. Centrifugal pumps are required per the SDU 6 PCHA [Ref. 5.5.45].
PR.3.2.3	PS	Drainwater Pumps and Valves	Return system shall allow remote control through the DCS and local hand manipulation. Valves shall be equipped with DCS position indication.	Local control required in case of DCS failure. Remote automation required to minimize personnel resources and exposure. DCS Valve Position Indicators are required per the SDU 6 PCHA [Ref. 5.5.45].
PR.3.2.4	PS	Drainwater Pump	The Drainwater Return System shall be designed and operated to minimize the presence of water within the SDU.	Drainwater removal to the maximum extent practical [Ref. 5.5.76].

Table 8

Function F3.2 – Return/Manage Drainwater

Performance Requirement Number	Functional Classification	Allocated to SSC	Performance Requirement Description	Basis
PR.3.2.5	PS	Drainwater Level Indicator	Provide DCS interlock switch to shutoff pump upon reaching low drainwater liquid level or a high liquid level in the SPF receipt tank. Provide DCS alarm upon reaching high drainwater liquid level in the SDU.	Low level switch provided to protect the pump. High level alarm provided to alert operations of increasing drainwater levels.
PR.3.2.6	PS	Drainwater Piping	The drainwater return transfer line shall tie-in to the existing drainwater line from SDU 3&5 to the SPF. The return line shall slope back to SDU 6 from the SDU 6 highpoint located at the perimeter of the cell. Downstream of the highpoint, the return line shall slope towards the tie-in point. The slope shall be a minimum of 1/16-inch per foot per P-PI-Z-0003, where applicable. In addition, the return line shall be equipped with flush water hose connection stub outs to allow the line to be flushed to remove potential pluggage.	Prevention of line pluggage.
PR.3.2.7 (Deleted)				

3.0 DESIGN CONSTRAINTS AND CRITERIA

3.1 General Design Constraints

National Consensus Codes and Standards supplemented by SRS Engineering Standards Manual (WSRC-TM-95-1) and SRS Engineering Practice Manual (WSRC-TM-95-58) as referenced herein shall be used as the primary source of technical criteria.

3.1.1 Permitting and Environmental Constraints

DC 3.1.1.1 The following SRS documents shall be provided if required. The appropriate Agency shall determine during the design phase if any additional permits are required:

1. Stormwater Management and Sediment Reduction Plan and Grading Permit
2. Power Services Utilization Permit – Parts A, B, & C
3. Automated Hazard Analysis (AHA)
4. Site Use and Site Clearance Permit
5. Radiological Work Permits
6. NESHAP Permit (New or Revision)
7. Industrial Solid Waste Landfill Permit
8. Environmental Evaluation Checklist – National Environmental Policy Act
9. Industrial Wastewater Permit
10. Performance Assessment (modeling)
11. Saltstone Disposal Facility Modified Permit
12. Project Fire Hazard Analysis (PFHA)

DC 3.1.1.2 Waste received in SDU 6 shall be disposed of in accordance with the approved SCDHEC Solid Waste Landfill Permit Modification issued in accordance with SCDHEC Regulation 61-107.19 SWM: Solid Waste Landfills and Structural Fill, approved Z- Area Industrial Wastewater Treatment Facility Permits (12,683-IW, 18,801-IW, 19,379-IW), the approved PA, and the Saltstone Facility WAC. Site and Solid Waste Landfill Permit Requirements regarding the disposal of grout are directed at a variety of goals, including protection of groundwater resources and maintaining the integrity of the facility through closure. Site selection, SDU design, the characteristics of the waste form, and closure methods were all considered in the formulation of the Waste Acceptance Criteria (WAC). The Saltstone Facility

WAC will be updated based on maintaining feed streams within the limits of the approved SCDHEC Solid Waste Landfill and Industrial Wastewater permits. An application to revise the existing SCDHEC permit shall be submitted as needed [Ref. 5.5.76].

3.1.2 Product and Process Characteristics

DC 3.1.2.1 The incoming salt solution waste stream for SPF will be from ARP/MCU, Effluent Treatment Process (ETP), and any residual material in Tank 50, during grout filling operation of SDU 6 [Ref. 5.5.82].

DC 3.1.2.2 SDU internal products

<u>Grout</u>

- Grout temperature inside SDU: 10°C to 70°C [Ref. 5.5.71]
- Grout density: 113 lbs/cf [Ref. 5.5.34 and 5.5.42]
- Grout PH: ~13.7
- Grout Rheology: Values to be derived from SDU 2 operating data
- Grout weight percent insoluble solids: 10 [Ref. 5.5.39]
- Grout Line Receipts:
  - Flush Water: System Design Pressure 183 psig, Design Temperature 22°C. [Ref. 5.5.90]
  - Pig and Pig Air: System Design Pressure 325 psig. [Ref. 5.5.92]
  - Grout: flow rate 150 gpm, temperature 0 to 40°C. [Ref. 5.5.91]
- The Salt Waste Feed Solution is 40 to 55 weight percent (wt%) of the grout [Ref. 5.5.34]

  <u>Dry Premix particle size and wt% information</u>
  - Slag ~ 10 microns (45 wt% of premix)
  - Cement ~ 20 microns (10 wt% of premix)
  - Flyash ~ 40-50 microns (45 wt% of premix)

<u>Saltstone (Cured Grout)</u>

- Saltstone density: 110 lbs/cf [Ref. 5.5.34]

<u>Drainwater</u>

- Drainwater temperature ranges from 10°C to 65°C. [Ref. 5.5.93]
- Drainwater density: 82 lbs/cf [Ref. 5.5.93 and 5.5.34]
- Drainwater viscosity estimated to be 1 to 2 cP.
- Drainwater is a Newtonian fluid with no yield stress.

3.1.3 Operations

DC 3.1.3.1 Anticipated operating environmental conditions inside SDU 6:

- SDU vapor space temperature: 0 to 52°C [Ref. 5.5.71]
- Relative humidity up to 100% condensing

DC 3.1.3.2 The operating environmental conditions outside SDU 6 [Ref. 5.5.74]:

- Ambient temperature: -11°C to 41°C
- Ambient relative humidity: 12-100%

DC 3.1.3.3 Drainwater collection system shall be secured to prevent system floating due to the density gradient between air and drainwater to saltstone, if applicable.

DC 3.1.3.4 SDU 6 capacity shall allow 2 feet for a clean grout cap, which limits the saltstone fill volume of SDU 6 to 41 feet (assuming a final design wall height of 43 feet).

DC 3.1.3.5 As a goal, the design and work planning will allow the SDU to be tied into the Saltstone facility in no more than 48 hours. This will require testing of equipment prior to the tie-in as well as careful planning in the preparation of tie-in points for the grout transfer and drainwater systems.

DC 3.1.3.6 For SDU design purposes, the internal SDU maximum grout temperature will be assumed to be 70°C and the minimum external temperature will be assumed to be 0°C, therefore, a worse case differential temperature across the SDU 6 (inside to outside) is assumed to be 70°C [Ref. 5.5.71].

3.1.4 Process Waste Generation

Possible waste generated by this modification will be evaluated in accordance with WSRC Engineering Manual E7, Procedure 1.41 Pollution Prevention in Design.

3.1.5 Construction Waste Constraints

DC 3.1.5.1 All solid waste generated, shall be handled and disposed of in accordance with WSRC 1S, Waste Criteria Manual, Section 3.

DC 3.1.5.2 Waste minimization and spread of contamination shall be controlled in accordance with WSRC 3Q, Environmental Compliance Manual, Procedure 6.11 and WSRC 5Q, Radiological Control Manual, Ch. 4.

3.1.6 Radiological

DC 3.1.6.1 The design and installation shall meet the requirements of SRS Engineering Standard No. 01064, "Radiological Design Requirements". The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupancy (2,000 hours per year) shall be to maintain exposure levels below an average of 0.5 mrem per hour (i.e., 1,000 mrem/person/year) and as far below this average as is reasonably achievable. Access to any Radiation Area shall be controlled [Ref. 5.5.65].

DC 3.1.6.2 The Design Agency shall interface with Radiological Engineering & Health Physics to obtain radiological design approval of all aspects of design dealing with protection of personnel from occupational hazards.

DC 3.1.6.3 SRS Engineering Standards Manual WSRC-IM-95-1, Standard 01064, Radiological Design Requirements. The Design Agency shall include the results in the design.

DC 3.1.6.4 Equipment installed inside SDU 6 will be subjected to the following radiological conditions [Ref. 5.5.65] (Values derived from draft version of calculation to be issued and approved in concurrence with final design):

- Drainwell – 6 Rad/hr (gamma)
- 30 cm from Grout surface – 807 mRad/hr

Equipment must meet design life requirement identified in Section 3.1.8, Reliability, Availability, Maintainability, and Inspectability (RAMI) Requirements.

DC 3.1.6.5 The design and installation shall be based on shielding requirements of 0.015 Ci/gal Cs-137. [Ref. 5.5.83]

3.1.7 Industrial Safety

DC 3.1.7.1 Equipment design and installation shall comply with the requirements of 29 CFR 1910 (OSHA) and WSRC Industrial Hygiene Manual 4Q, Sections 1200 and 1300.

DC 3.1.7.2 The design shall provide a NFPA 101 compliant stair tower for emergency egress and operational accessibility.

3.1.8 Reliability, Availability, Maintainability, and Inspectability (RAMI) Requirements

DC 3.1.8.1 All components shall be installed in an accessible location for inspections with the following exceptions for equipment located inside the SDUs:

- thermocouple trees are sacrificial
- interior lighting not mounted on cameras is sacrificial (not preferred)
- cameras must be removable for maintenance
- drainwater pumps must be removable for maintenance

DC 3.1.8.2 The design life for SDU instrumentation located inside or near the SDU shall be five years, when based on radiological rates [Ref. 5.5.56].

DC 3.1.8.3 Instrumentation shall be remotely mounted from the sensors in radiation fields whenever possible to extend the design life of the transmitter.

DC 3.1.8.4 The design life of the SDU structure shall be a minimum of 25 years from date of construction completion [Ref. 5.5.56, last SDU to be filled in 2032, closure activities to proceed after].

DC 3.1.8.5 Delete

DC 3.1.8.6 The location of the drainwater pumps shall consider the potential for removal during operations and take in to account crane reach limitations and location of above grade encumbrances.

DC 3.1.8.7 Crane access shall be provided, as necessary, to maintain operability of SDU 6.

DC 3.1.8.8 The CLFL monitoring sample taps shall be installed at easily accessible locations for vapor space sampling by personnel (Operations). One sample tap shall be located near the wall (perimeter) of the cell.

DC 3.1.8.9 The design of passive vents shall be compatible with SDU 2, 3, & 5 (i.e., to allow passive vents from other SDUs to be retrofitted to SDU 6).

DC 3.1.8.10 The grout piping shall be designed to include the ability to disconnect and replace if pluggage occurs.

3.1.9 Human Factors

DC 3.1.9.1 Guide 13012-G (Application of Human Factors Engineering Standards for SRS Process Control Systems Design) shall be considered in applying human factors for user operability, applications, maintenance, accessibility, testability, dependability, standardized conventions, and nomenclature.

3.1.10 Quality Assurance

DC 3.1.10.1 This modification shall comply with the WSRC 1Q, Quality Assurance Manual, and procedures that implement these requirements.

DC 3.1.10.2 Project specific quality assurance activities shall be in accordance with the Saltstone Disposal Unit 6 Quality Assurance Plan (Ref. 5.5.59). This plan will orchestrate all aspects of quality and the right graded approach to inspect every aspect of the work.

3.1.11 Fire Protection

DC 3.1.11.1 This modification shall comply with the requirements in SRS Engineering Standard 01120 “SRS Fire Protection Design Criteria”.

DC 3.1.11.2 SDU interior coating shall meet the requirements of Class A and Class I, as defined in SRS Engineering Standard 01120 “SRS Fire Protection Design

Criteria". If required to reduce thermal stresses in the SDU structure, external insulation must meet Class A requirements, except for smoke development [Ref. 5.5.79].

DC.3.1.11.3 SDU 6 shall comply with DOE-STD-1066, Chapter 13 and 14.

3.2 SSC Configuration and Design Constraints

3.2.1 Civil and Site work

DC 3.2.1.1 Structures associated with this project shall be designed and constructed in accordance with WSRC-TM-95-1, Standard 01060, "Structural Design Criteria". System/component supports shall be designed and constructed in accordance with WSRC-TM-95-1, Standard 01061, "Qualification of Systems, Equipment & Components for Natural Phenomena Hazards".

DC 3.2.1.2 Civil and Site work design shall comply with WSRC-TM-95-1, Standard 01110 "Civil Site Design Criteria".

DC 3.2.1.3 The placement of SDU 6 shall be specified and placed so that it can accommodate the future closure cap to be installed over the disposal units. The future closure cap for the SDUs will consist of various soil layers that will have an anticipated minimum thickness of approximately 13 ft. above the SDU roof (Ref. 5.5.12& 5.5.16).

DC 3.2.1.4 The SDU 6 design-build constraints provided in the table below are based on Preliminary Performance Assessment Modeling Inputs [Ref. 5.5.64] and modeling constraints provided in Technical Task Request to support Special Analysis [Ref. 5.5.89]. Adherence to these criteria will ensure protection of the inputs and assumptions being used to develop the Special Analysis.

SDU-6 Design/ Build Constraints

	Critical Dimension	Material Type
Cell Diameter	375 ft. (nominal)	N/A
Cell Height	43 ft. (nominal internal wall height)	N/A
Support Columns	208 (maximum) – 24 in. Dia. (25 in. Dia. maximum)	High Quality Concrete
Roof	12 in. (9 in. minimum) with Slope 1.5% (1% minimum)	High Quality Concrete
Roof Joints	750 ft. (1,000 linear ft. maximum)	PVC
Floor Thickness	12 in. (9 in. minimum)	High Quality Concrete
Floor Joints	750 ft. (1,000 linear ft. maximum)	PVC
Wall Thickness	Tapered 24 in. to 10 in. (20 in. – 8 in. minimum)	High Quality Concrete
Form Tie-Through Repair	8 in. (7 in. minimum) HQC/ plug / LQC	High Quality Concrete (HQC) Low Quality Concrete (LQC)
Lower High Density Polyethylene (HDPE)-Geosynthethic Clay Liner (GCL)	HDPE 100 mil (+/- 5%) HDPE including GCL 0.3 in. minimum thickness	HDPE GCL
Floor Foundation Elevation	265 ft. (minimum) Note 1	N/A
SDU Centerline Location	N 77687 (+/- 50 ft.) E 66430 (+/- 50 ft.)	N/A

Note 1: The SDU Foundation Slab Elevation is defined as the low point of the foundation slab.
Note 2: High Quality Concrete refers to Type V Mix Design identified in Reference 5.5.42, Attachment 03300-A.

DC 3.2.1.5 The grade shall provide a minimum 1% slope away from the floor wall joint to minimize perched water conditions.

DC 3.2.1.6 Deleted.

DC 3.2.1.7 SDU 6 roof shall include any pads, footings, or embeds required for equipment and mounting of grout line, ventilation ducting, and drainwater piping. Roof penetrations shall be designed in a manner to prevent rainwater infiltration [Ref. 5.5.8].

Provide other pads or footings as needed to support equipment along the side of the SDU.

DC 3.2.1.8 SDU 6 joint seals, walls, floors, and roof shall prevent liquid seepage to the exterior of the SDU and prevent intrusion of rainwater. SDU structure shall be able to withstand hydrostatic head created by internal liquids (Drainwater 41 ft. at 82 lbs/cf.).

DC 3.2.1.9 Storage and laydown areas shall have space for equipment servicing, and access roads to deliver materials and equipment.

DC 3.2.1.10 SDU 6 shall be designed and constructed to allow for backfilling around the SDU when full of saltstone.

DC 3.2.1.11 SDU 6 shall be designed to account for a negative pressure of 4 inches water column [Ref. 5.5.72].

DC 3.2.1.12 Provide markers for SDU settlement surveys and perform settlement monitoring as required per WSRC-IM-95-58 (Standard 02223-G). For SDU 6, the settlement basis is provided in the Ref. 5.5.61, K-CLC-Z-00024, Rev. 0 “Bearing Capacity and Static Settlement Calculation for Saltstone Disposal Unit 6”, March 2012.

DC 3.2.1.13 Deleted

DC 3.2.1.14 The SDU shall be a AWWA D110 Type I tank design in accordance with ACI 350 and leak tested in accordance with ACI 350.1. The leak tightness criteria is specified in PR 2.2.2.

DC 3.2.1.15 Deleted

DC 3.2.1.16 Deleted

DC 3.2.1.17 SDU 6 shall be constructed using the Type V Mix Design identified in Reference 5.5.42, Attachment 03300-A.

DC 3.2.1.18 Deleted

DC 3.2.1.19 Exterior HDPE & GCL liners beneath the SDU will require protection from rainwater intrusion during operation and prior to backfill and closure. The wall

and roof HDPE liner are not part of this project scope. See Section 4.3.1 for additional clarification

DC 3.2.1.20 Deleted

DC 3.2.1.21 The tank top and foundation loads shall be within the capacities provided in the SDU cell design. Design shall support tank top provisional ventilation skid loading = 10,000 lbs./6 ft. x 28 ft. (59.5 lbs./ft^2)

3.2.2 Disposal Unit Siting Considerations

DC 3.2.2.1 The siting of SDU 6 shall be in accordance with siting of future SDUs [Ref. 5.5.41].

3.2.3 Mechanical

DC 3.2.3.1 Piping systems shall meet ASME B31.3 requirements and comply with WSRC-TM-95-1, Site Standard 15060, Additional Requirements for SRS Piping Systems, and T-ESR-S-00010, Engineering Report Defense Waste Processing Facility Piping Specifications. A grout line shall be connected to SDU 6 from an existing grout line. DCS controlled piggable valves with DCS position indication shall be provided for switching between SDU 6 pour locations. Routing of the grout line shall consider future SDU locations.

DC 3.2.3.2 The Drainwater return line shall include siphon prevention.

DC 3.2.3.3 Provide two isolation valves between drainwater return lines from different SDU cells and vaults to prevent the potential for inadvertent transfers.

DC 3.2.3.4 Components (piping, vessels, and instrumentation) susceptible to freezing shall be provided with freeze protection.

DC 3.2.3.5 SDU fluid services are provided in Table 9 below. The design pressure and temperature shall be determined by the Design Agency based on the most severe condition of coincident system pressure and temperature expected during service.

Fluid	ASME B31.3 Fluid Service
Grout Line	Normal
Drainwater Return	Normal
Passive Ventilation	N/A
Provisional Active Ventilation	N/A
Drainwell Ventilation	N/A

Table 9: SDU Fluid Services Parameters

DC 3.2.3.6 Components and supports shall consider tank settlement per K-CLC-Z-00024, Bearing Capacity and Static Settlement Calculation for Saltstone Disposal Unit 6 (Ref. 5.5.61).

DC 3.2.3.7 The SDU 6 ventilation system(s) shall comply with NFPA 91.

DC 3.2.3.8 Existing SPF and SDF grout piping is DWPF pipe specification DWPF-P254 and existing SPF and SDF Drainwater piping is DWPF piping specification DWPF-P224 [Ref. 5.5.67]. Any new Drainwater piping shall be stainless steel [Ref. 5.5.45].

DC 3.2.3.9 Materials of construction shall perform their intended functions when exposed to the environmental conditions to which installed.

DC 3.2.3.10 The Provisional Active and Passive Ventilation System shall comply with ASME AG-1.

DC 3.2.3.11 The BOP design shall comply with structural design limitations of the SDU [Ref. 5.5.72].

DC 3.2.3.12 The drainwell ventilation system shall not introduce additional organics into the SDU 6 vapor space (i.e., oil free).

DC 3.2.3.13 The SDU shall be constructed with a passive ventilation system and drainwell ventilation system for removal of flammable vapors in accordance with NFPA 69.

3.2.4 Electrical

The electrical work includes any miscellaneous electrical loads associated with the SDU installation. This project will supply electrical service and electrical distribution for:

1. SDU 6 Area Lighting
2. Cameras, Lighting, & Instrumentation
3. Drainwater Return Pumps
4. Thermocouples/temperature monitoring system
5. Motor Operated Valves
6. Welding/Convenience receptacles
7. Provisional Active Ventilation system power
8. I/O Equipment

DC 3.2.4.1 Power for electrical loads shall be from Z-Area utilities.

DC 3.2.4.2 The camera controls (power and signal) shall be mounted in a weatherproof enclosure to preclude rain water intrusion.

DC 3.2.4.3 The electrical design of this facility shall comply with NFPA-70, (2008), ANSI/IEEE C2. Consideration shall be given to easy disassembly and relocation of power distribution and equipment to other SDUs. Routing of instruments and power lines shall also consider future SDU locations.

DC 3.2.4.4 Electrical equipment shall comply with SRS Site Guides 16053-G, 16980-G, & ANSI/IEEE C2.

DC 3.2.4.5 Any conduit penetrating fire-rated assemblies shall be non-combustible and the complete installation shall be sealed to maintain the fire rating per UL 1479 and UL building materials directory.

DC 3.2.4.6 Electrical raceway systems shall comply with SRS Engineering Guide 16051-G.

DC 3.2.4.7 Wiring shall comply with SRS Guide 16052-G.

DC 3.2.4.8 Grounding systems shall comply with SRS Engineering Guide 16056-G. Per the SDIT, Lightning protection is not warranted for SDU 6 [Ref. 5.5.88, A formal engineering evaluation per 2Q-2.12 will be submitted for DOE approval concurrent with final design]. Surge protection shall

be considered for sensitive electronic equipment [Ref. 5.5.79].

DC 3.2.4.9 Electrical design shall comply with SRS Engineering Standard 16050.

DC 3.2.4.10 All electrical components inside the drainwells, surrounding area within 25 feet of each drainwell, and exterior leak detection sumps (not shown in Figure 5 below) shall be considered Class I, Division 2 in accordance with NFPA 70, Article 500 requirements. All other electrical components are considered Unclassified.

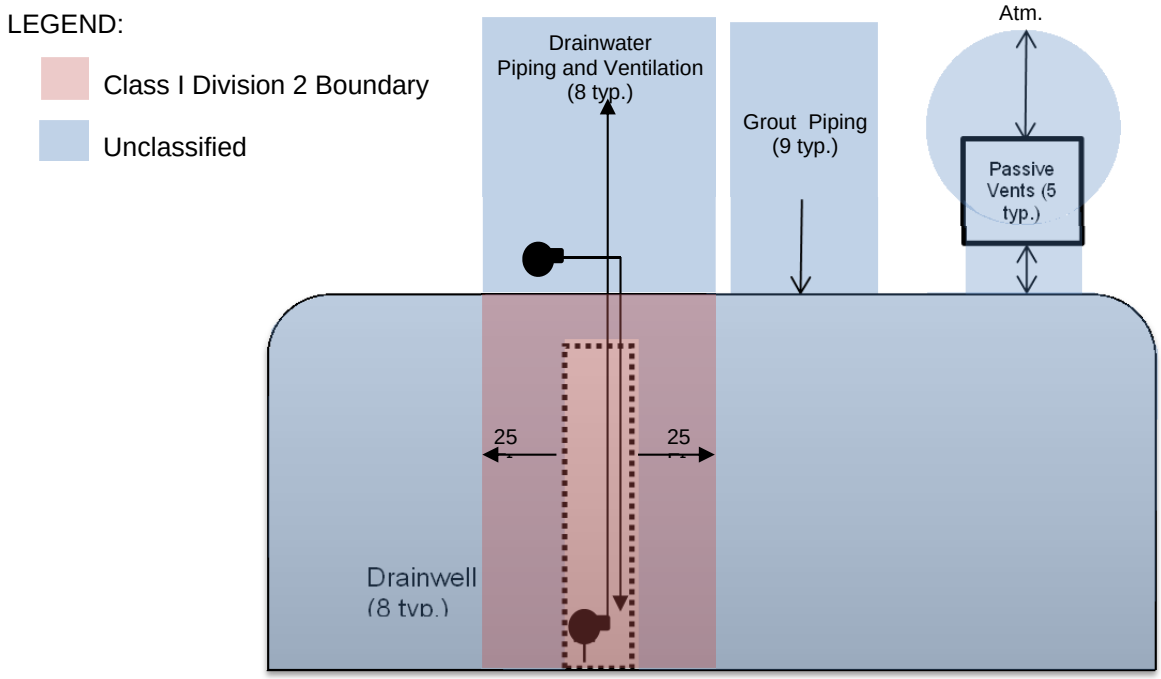

Figure 5 SDU 6 Hazards Classification Boundaries

DC 3.2.4.11 Motors shall meet NEMA MG-1 requirements.

DC 3.2.4.12 Arc Flash labeling shall be installed per SRS Manual 18Q, Procedure 2 and SRS Engineering Guide 16070-G.

DC 3.2.4.13 All equipment that is temporarily utilized for the grout filling operation of SDU 6 shall be skid-mounted, as practical, for reuse with future SDUs as a cost savings effort (e.g., provisional active ventilation skid, MIEES)

DC 3.2.4.14 Delete

DC 3.2.4.15 Delete

DC 3.2.4.16 Components and supports shall consider tank settlement per K-CLC-Z-00024, Bearing Capacity and Static Settlement Calculation for Saltstone Disposal Unit 6 [Ref. 5.5.61].

DC 3.2.4.17 Electrical equipment, instrumentation, cables, raceways and wiring terminations shall perform their intended functions when exposed to the environmental conditions to which installed.

DC 3.2.4.18 Normal and emergency lighting shall be provided in accordance with NFPA 101.

3.2.5 Instrumentation and Controls

The Instrumentation and Control philosophy is contained within the Automation and Control Strategy (to be developed).

DC 3.2.5.1 Instrumentation shall be designed to provide access for maintenance, calibration, testing, and troubleshooting except for sacrificial thermocouple trees.

DC 3.2.5.2 New instrumentation shall be procured with self-monitoring features where possible.

DC 3.2.5.3 The SS instrumentation design for this activity shall comply with Ref. 5.5.37. In addition, the activity shall use 01703-G, “Design Guidance for Instrumented Systems That Are Used in SS and Hazardous Processes”.

DC 3.2.5.4 Instrumentation and Controls design shall be in accordance with SRS Engineering Standard 15980.

DC 3.2.5.5 Components and supports shall consider tank settlement per K-CLC-Z-00024, Bearing Capacity and Static Settlement Calculation for Saltstone Disposal Unit 6 (Ref. 5.5.61).

DC 3.2.5.6 All components and instrumentations shall fail to a "safe" condition on a loss of power.

DC 3.2.5.7 The SDU 6 PCHA [Ref. 5.5.45] has not identified any safety related instrumentation and/or controls which will be required to provide remote control room indication and/or an automatic action.

DC 3.2.5.8 Design will provide adequate spare capacity (cable trays, DCS I/O, Foundation Field bus, DeviceNet, structural supports, etc.) for provisional active ventilation system.

3.2.6 **Facility Operations** and **Maintenance**

The modification of a facility and the selection of materials shall include features that facilitate operations and maintenance. For ease of operations and maintenance the design shall consider the following:

- Locating process and radiological monitoring readouts and equipment outside of radiological areas
- Life expectancy and reliability of equipment to be maintained in radiological areas
- Quick connect fittings or quick opening fasteners versus bolted or welded connections
- Components containing radiological material or fluids must be easily drained, flushed and/or cleaned by chemical or mechanical means
- Remote valve operators versus manual valve operators

The modification shall incorporate measures to simplify decontamination of areas that may become contaminated with radioactive or hazardous materials. Items such as service piping, conduits, and ductwork shall be kept to a minimum in potentially contaminated areas. Equipment shall be arranged to facilitate decontamination.

DOE-HDBK-1132-99 [33] Part I Section 2.12 contains additional guidance that shall be considered.

4.0 SUPPORTING INFORMATION

4.1 Technology Preferences

4.1.1 Tank Construction

A concrete water tank design is the preferred technology for the disposal of saltstone grout. This technology has been used for the construction of SDU 2, 3, & 5.

4.2 Summary Design Concept

The concrete water tank will be designed as an AWWA D110 Type I tank in accordance with ACI 350 and leak tested in accordance with ACI-350.1. The tank design will be performed concurrently with the preparation of the site. The preparation of the site is not part of this TR&C scope; see Ref. 5.5.60. Site preparation will include clearing/grubbing, installation of site access roads, installation of fence gates, grading and excavating, and the installation of erosion control components (installation of underwater drainage pipes, construction of sedimentation basin with outfalls, diversion channels with check dams, silt fences, and seeding).

Once the tank design and the site have been prepared, construction of the tank structure will commence. The site preparation, tank construction, and portions of the BOP will be performed as a Greenfield project. BOP portions related to facility tie-ins will not be considered Greenfield.

4.3 Synthetic Liners

4.3.1 Use of HDPE Geomembrane

A High Density Polyethylene (HDPE) Geomembrane will be placed on the outside of the SDU in order to form a composite hydraulic barrier. Initially the HDPE liner will only be installed under the tank, later, prior to backfilling, the liner will be extended to cover the entire tank. Backfilling and extending the liner is outside of the scope of this document. The geomembrane will be 100-mils thick and shall conform to the requirements of GRI (2003). The geomembrane will be designed to promote lateral drainage and minimize infiltration to the SDU [Ref. 5.5.43 and 5.5.8].

4.3.2 Geosynthetic Clay Liner (GCL) Requirements

A Geotextile GCL is a relatively thin layer of processed bentonite fixed between two sheets of geotextile. The GCL is typically 0.2 to 0.3 inches thick and contains a minimum of 0.75 pounds (oven-dried weight) of sodium bentonite per square foot of GCL. The geotextile is a woven or non-woven sheet material resistant to penetration [Ref. 5.5.43 and 5.5.8].

5.0 REFERENCES

NOTE: Unless otherwise specified, the latest revision of the following references shall be used.

5.1 Government Regulations, Orders, and Standards

5.1.1 Codes of Federal Regulations (CFR)

10 CFR 830, Documented Safety Analysis

10 CFR 835, DOE Occupational Radiation Protection

10 CFR 851, Worker Safety and Health Program

29 CFR 1910, Occupational Safety and Health Standards (OSHA)

5.1.2 DOE Orders and Standards

DOE Order 420.1	Facility Safety
DOE Std. 1020	Natural Phenomena Hazards Performance Categorization Guidelines for Structures, System, and Components
DOE Std. 1021	Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components
DOE Std. 1027	Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.3, Nuclear Safety Analysis Reports
DOE Std. 1066	Fire Protection Design Criteria
DOE Std. 1189	Integration of Safety into the Design

DOE M 435.1-1	Radioactive Waste Management Manual

5.1.3 State Regulations (SCDHEC)

Regulation 61-62	Air Pollution Control Regulations and Standards
Regulation 61-67	Wastewater Facility Construction
Regulation 61-107.19	Solid Waste Management: Solid Waste Landfills and Structural Fill
Regulation 72-300	Standards for Stormwater Management and Sediment Reduction

5.2 Applicable Industry Codes and Standards

The project shall utilize SRS Engineering Standards Manual WSRC-TM-95-1 Attachment 1 “National Codes and Standards for Engineering / Design Tasks Matrix”, Code/Standard Evaluations, along with the Code of Record Basis Document [Ref. 5.5.94].

5.3 SRS Procedures Manual

WSRC 1Q	Quality Assurance Manual
WSRC 1S	Waste Acceptance Criteria Manual
WSRC 3Q	Environmental Compliance Manual
WSRC 4Q	Industrial Hygiene Manual
WSRC 5Q	Radiological Control Manual
WSRC 11Q	Facility Safety Document Manual
WSRC E7	Conduct of Engineering and Tech Support

5.4 SRS Engineering Manuals

WSRC-IM-95-58	SRS Engineering Practices Manual
WSRC-TM-95-1	SRS Engineering Standards Manual

5.5 Other Relevant Documents

5.5.1 Deleted

5.5.2 WSRC-TR-2005-00131, Rev. 0, “Determination of the Probable Maximum Water Table Elevation (U)”.

5.5.3 WSRC-TR-2008-00090, Rev. 0, “Saltstone Vault #2 Interior Lining Review (U)”.

5.5.4 M-TC-Z-00004, Rev. 6, “Saltstone Facility Cylindrical Vault #2 Project TR&C”.

5.5.5 WSRC-TR-2005-00101, Rev. 0, "Scoping Study HDPE in SS Service".

5.5.6 WSRC-SA-2003-00001, "Saltstone Facility Documented Safety Analysis", Revision 9.

5.5.7 CBU-PIT-2005-00095, Rev. 0, “Chemical Concentrations in Salt Solution Feeds”.

5.5.8 07-ALJ-07-121-CC, Rev. 0, “Consent Order of Dismissal”.

5.5.9 X-SD-Z-00001, Rev. 11, “Waste Acceptance Criteria for Aqueous Waste Sent to the Z-Area Saltstone Production Facility (U)”.

5.5.10 LWO-LWE-2008-00269, Campbell S.G., Rev. 0, “Salt Batch 1 Decontamination Factors for ISDP”

5.5.11 P-CLC-Z-00003, Rev. 0, “Determination of the Vault 2 Cell Grout Height Uncertainty”

5.5.12 WSRC-STI-2008-00244, Rev. 0, “Saltstone Disposal Facility Closure Cap Concept and Infiltration Estimates”.

5.5.13 LWO-SPT-2008-00100, Rev. 0, “Planning Dose Rate for Salt Disposal Integration Project (SDIP) Modifications”.

5.5.14 AC51636A, Sheet 34, Rev. F, “C1012 LaFarge V Length Change Due to Sulfate Exposure”.

5.5.15 WSRC-RP-92-1360, Rev. 0, “Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility”.

5.5.16 SRR-CWDA-2009-00017, Rev. 0, “Performance Assessment for the Saltstone Disposal Facilities at the Savannah River Site”.

5.5.17 J-RS-Z-00005, Rev. 2, “Saltstone Temperature Monitoring System Requirements Specification for Software (U)”.

5.5.18 WSP-SSF-2005-00023, Rev. 1, “Z-Area Industrial Solid Waste Landfill Permit # 025500-1603 Closure Plan Engineering Report”.

5.5.19 J-DCP-Z-09002, Rev. 0, “Installation of SS PLC Temperature Monitoring System for Vault 2, Cells 2A and 2B as an Integral Part of Vault 4 PLC System”.

5.5.20 Deleted

5.5.21 WSRC-TR-2007-00162, Rev. 1, “Safety Design Strategy for Vault 2 Organics Modifications Project”.

5.5.22 S-CLC-Z-00075, Rev. 0, “Maximum Grout Heights to Remain Below the Composite Lower Flammability Limit for Saltstone Vault 2”.

5.5.23 S-CLC-Z-00039, Rev. 3,“Saltstone Facility Vault Explosion Chemical Evaluation (U)”.

5.5.24 LWO-WSE-2006-00153, “Engineering Position on Functional Classification Boundary for Vault 4 Organic Modifications Temperature Interlocks”, October 2006.

5.5.25 WSRC-TR-2006-00058, Rev. 0, “Saltstone Sheet Drain Performance Results”.

5.5.26 WSRC-TR-2005-00288, Rev. 0, “Computational Fluid Dynamics Model for Saltstone Vault 4 Vapor Space”.

5.5.27 S-CLC-Z-00041, Rev. 0, “Salt Feed Line and Grout Line Shielding for Saltstone 0.2 Ci per Gallon Modifications”.

5.5.28 S-CLC-Z-00056, Rev. 1, “Saltstone Leachate Return System Shielding Evaluation for Receipt of ARP/MCU Decontaminated Salt Solution in Vault 4 Cells B & H”.

5.5.29 X-CLC-Z-00033, Rev. 3, “Proposed Chemical Compounds and Concentration Limits for Saltstone Salt Solution”.

5.5.30 J-CLC-Z-00007, Rev. 0, “Instrumentation Uncertainties Evaluation Vault #2 Train A & B Temperature”.

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5.5.32 SRR-2011-00026, “Agreement on Key Input Bases and Assumptions for Revision 17 of the Liquid Waste System Plan”

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5.5.34 S-CLC-Z-00044, Rev. 7, “Input Data and Assumption for Saltstone Facility”

5.5.35 SRR-SPT-2011-00113, Rev. 0, “SDU-6 Performance Assessment Initial Modeling Inputs”.

5.5.36 G-ADS-Z-00004, Rev 0, “Saltstone Disposal Units 6 & 7 Value Engineering Study”.

5.5.37 WSRC-TM-95-1, SRS Engineering Standard 01703, Rev. 7, “Application of ISA 84.00.01 Part 1 for Non-Reactor Facilities.”

5.5.38 SRNL-STI-2010-00167, “Design and Testing of the Formed Core Sampling System for Saltstone Facility Vaults”

5.5.39 AC47311A-2-WM4, Rev. A, “Design and Engineering Design Parameters”

5.5.40 WSRC-TM-95-1, SRS Engineering Standard 01060, Rev. 10, “Structural Design Criteria”

5.5.41 SRR-SDU-2011-00002, Rev. 0, "Siting of Future Saltstone Disposal Units", January 2012

5.5.42 C-SPP-Z-00007, Rev. 2, ”Saltstone Disposal Cells 3 and 5”

5.5.43 WSRC-STI-2008-00244, Rev. 0, “Saltstone Disposal Facility Closure Cap Concept and Infiltration Estimates”, Revision 0.

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5.5.45 S-CHA-Z-00005, Rev. C, “Preliminary Consolidated Hazard Analysis” June 2013

5.5.46 G-ADS-Z-00001, Rev. 0 “Saltstone Vault Study”, July 2003

5.5.47 SRR-SDU-2012-00007, Rev. 0 “System Engineering Evaluation Saltstone Grout Pump” March 2012

5.5.48 S-CLC-Z-00104, Rev. C, “Flammability Analysis for Saltstone Facility SDU-6 Pouring Operation”

5.5.49 CBU-WSE-2005-00276, Rev. 2 “Recommended Waste Acceptance Criteria (WAC) for Transfers from the Salt Waste Process Facility (SWPF) to the Defense Waste Processing Facility (DWPF) and Saltstone Production Facility (SPF)

5.5.50 SRNL-STI-2011-00665, Rev. 0, “Operational and Compositional Factors that Affect the Performance Properties of ARP/MCU Saltstone Grout”

5.5.51 SRR-LWP-2012-00044, Rev. 0 ”Memorandum of Understanding Saltstone SDU 6/7 Project” June 2012

5.5.52 CBU-WSE-2005-00019, Rev. 0, “Evaluation of Options for Configuration of Proposed Saltstone Vault #2”

5.5.53 SRR-SDU-2011-00008, Rev. 1, “Selection of a 32 million gallon AWWA D 110 Type I tank design for SDU 6”, July 2012

5.5.54 SRNL-STI-2012-00109, “Evaluation of Fabric Membranes for Use in Saltstone Drain Water System”, March 2012

5.5.55 Y-RAR-Z-00012, Rev. 0, “Saltstone Disposal Unit (SDU) 6 Project Risk and Opportunity Analysis Report”, July 2012

5.5.56 SRR-LWP-2009-00001, Rev. 18, “Liquid Waste System Plan” (Draft)

5.5.57 G-TDP-Z-00001, Rev. 1, “Saltstone Disposal Unit 6 Technology Development Program Plan”, November 2012

5.5.58 G-ADS-Z-00003,” Rev. 0 “Saltstone Decontaminated Salt Solution System Engineering Evaluation”, July 2011

5.5.59 G-PSQ-Z-00001, Rev. 3 “Saltstone Disposal Unit 6 Quality Assurance Plan”

5.5.60 C-SPP-Z-00010, Rev. 0 “Saltstone Disposal Site – SDU 6 Site Preparation”

5.5.61 K-ESR-Z-00005, Rev. 0 “Saltstone Disposal Unit 6 Geotechnical Investigation Report”

5.5.62 G-ESR-Z-00012, Rev. 2, “Saltstone Disposal Unit 6 Reliability, Availability, Maintainability, and Inspectability”

5.5.63 X-CLC-Z-00045, Rev. 0 “Saltstone Facility Basis Information for Content Order of Dismissal Section III.7 Website Data- Fourth Quarter”

5.5.64 SRR-SDU-2012-00021, Rev. 0, “SDU-6 Modeling Inputs for Preliminary PA Modeling”

5.5.65 N-CLC-Z-00027, Rev. 0, “Saltstone Disposal Unit (SDU) 6 Dose Rates and Bulk Shielding Evaluation” (Draft)

5.5.66 U-SDS-Z-00001, Rev. 2, “Safety Design Strategy for SDU 6 Project”

5.5.67 T-ESR-S-00010, Rev. 8, “Engineering Report Defense Waste Processing Facility Piping Specification”

5.5.68 G-SOW-Z-00004, Rev. 2, “Mega Saltstone Disposal Unit Computational Fluid Dynamics Model”

5.5.69 G-TTR-Z-00001, Rev. 0, “SLA 52 – Line Item 13: SRNL Laboratory Testing Task for SDU#6”

5.5.70 SRNL-L3010-2011-00231, Rev. 0, “Evaluation of Draft Saltstone Disposal Unit 6 Technology Development Program Plan” December 2011

5.5.71 M-CLC-Z-00111, Rev. 0, “Saltstone Disposal Unit 6 Temperature Profiles During Grout Pouring”

5.5.72 C-CLC-Z-00063, Rev. 0, “SDU 6 Tank Calculation”

5.5.73 M-CLC-Z-00107, Rev. A, “Active Ventilation Fan Sizing Calculation”

5.5.74 Savannah River National Laboratory Atmospheric Technologies Center, http://shweather.srs.gov/Weather/

5.5.75 SRNL-STI-2012-00522, Rev. 0,”Evaluation of the Impact of Thin Pours on Saltstone Properties”

5.5.76 SRR-ESH-2012-00045, Rev. 0, “Application for Modification, Savannah River Site Z-Area Saltstone Disposal Facility ID # 025500-1603, Engineering Report for SDU Construction” May 2012

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5.5.80 SRNL-L3100-2012-00161, Rev. 0 “Long-Radius Saltstone Flow Test: Observations Report” November 2012

5.5.81 M-CLC-Z-00115, Rev. 0, “SDU 6 Drainwater Well Purge Analysis in Support of NFPA 69”

5.5.82 SRR-CAA-2013-00028, CONTRACT DE-AC09-09SR22505-Agreement on Key Input Bases and Assumptions for Revision 18 of the Liquid Waste System Plan

5.5.83 X-ESR-H-00456, Rev. 0, “Estimated Cesium Concentration in Tank 50”

5.5.84 S-CLC-Z-00115, Rev. 0, “Saltstone Facility SDU 6 Flammability Analysis (U)”

5.5.85 SRNL-STI-2013-00083, Rev. 0, Modeling Multiple Chemical Emissions near Saltstone Facility for SDU 6 Ventilation System

5.5.86 SRNL-STI-2012-00109, Rev. 0, Evaluation of Fabric Membranes for Use in Saltstone Drain Water System

5.5.87 SRRA011088, Sheet 2, Rev A, Saltstone Disposal Unit 6 Computational Fluid Dynamics Modeling

5.5.88 SRR-SDU-2013-00014, Rev 0, SDU 6 SDIT Meeting Minutes

5.5.89 HLW-SSF-TTR-2013-0021, Rev. 0, 30 Million Gallon Saltstone Disposal Unit PORFLOW Modeling for FY13 Special Analysis

5.5.90 M-DS-Z-00012, Rev. 0, Centrifugal Pump Data Sheet 210-Z Facility High Pressure Flush Pump Z-210-SSMT-P-9007 (U)

5.5.91 M-DS-Z-00008, Rev. 5, Saltstone Modification Project Grout Pump and Accessories

5.5.92 W775547, Rev. 25, Saltstone Pig Launching Piping and Instrumentation Diagram Savannah river Plant -200Z Area DWPF-Saltstone Process/Instr Nuclear/Cont Sys

5.5.93 M-TC-Z-00007, Rev. 6, Saltstone Facility Disposal Units #3 & #5 Project, Bldg. 451003Z and 451005Z

5.5.94 G-ESR-Z-00013, Rev. 2, Salt Disposal Unit 6 Code of Record Basis Document

5.5.95 M-CLC-Z-00106, Rev. 0, SDU 6 Peristaltic Grout Pump Pressure Hydraulic Calculation (DRAFT)

5.5.96 AC47311, Sh. 3, Rev. A, SPX 100 Duplex Hose Pump Engineering and Technical Data

5.6 Drawings

5.6.1 C-CC-Z-00046 “Tank Design Concrete Details”

6.0 FIGURES AND SKETCHES

Figure 1	Conceptual Drainwater System
Figure 2	Systems Interface Diagram
Figure 3	Upper Level System Functions
Figure 4	SDU Functional Hierarchy Diagram
Figure 5	SDU 6 Hazards Classification Boundaries

7.0 ATTACHMENTS

Attachment 1	Deleted