PENDING CHANGES TO THE SALTSTONE FACILITY SAFETY BASIS MANUAL
## Revision History

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<td>Added TSR Change 2006-A.</td>
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<td>12</td>
<td>08/02/2006</td>
<td>Deleted WSRC-SA-2003-00001 Rev. 4, (Annual Revision) and S-TSR-Z-00002 Rev. 4 (Annual Revision) and added a complete PDF version of WSRC-SA-2003-00001 Rev. 4, (Annual Revision) and S-TSR-Z-00002, Rev. 4 (Annual Revision).</td>
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<td>18</td>
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<td>Added revised TSR 5.6.2.2, Vault 4 Cell Fill Limit, per the Condition of Approval from DOE SER.</td>
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<td>Added a complete PDF version of WSRC-SA-2003-00001 Rev. 7, (Annual Revision) and S-TSR-Z-00002 Rev. 7 (Annual Revision) which incorporated the receipt and processing of MCU material containing “full” organics.</td>
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<td>28</td>
<td>08/17/2009</td>
<td>Added SBD-CRF-Z-09002.</td>
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<td>11/13/2009</td>
<td>Added SBD-CRF-Z-09003 Rev. 0. Added revision numbers to pending CRFs.</td>
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<td>31</td>
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<td>34</td>
<td>11/17/2010</td>
<td>Added SBD-CRF-Z-10008 Rev. 0 and SBD-CRF-Z-10008 Rev. 1. Applied consistent format to Table of Contents.</td>
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<td>Added SBD-CRF-Z-11001 Rev. 0.</td>
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<td>47</td>
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<td>Substituted pages v, 3-29 through 3-34, and 3-40 in WSRC-SA-2003-00001 Rev. 9.</td>
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<td>SBD-CRF-Z-12005 Rev. 1, SBD-CRF-Z-12007 Rev. 0, SBD-CRF-Z-12008 Rev. 0, and SBD-CRF-Z-12009 Rev. 0.</td>
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<td>77</td>
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<td>87</td>
<td>06/25/2019</td>
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<td>SWPF Integration (DSA Rev. 15)</td>
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<td>Chemical Screening (DSA Rev. 15)</td>
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<td>SBD-CRF-Z-19003, Rev. 0 (06/25/19)</td>
<td>Grout Pump Head Vent Conductivity Probes (DSA Rev. 15)</td>
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**Pending Changes to S-TSR-Z-00002**

None

**Other Safety Basis Documents**

None
SAFETY BASIS DOCUMENT CHANGE REQUEST (CRF) FORM

1. SBD Change Request Form No.: SBD-CRF-Z-19001 Revision No.: 0
   Manual: WSRC-IM-2004-00028 Date: Jan 2019

2. SBD No.: WSRC-SA-2003-00001 Title: Saltstone Facility Documented Safety Analysis
   Rev/Date: 15 July 2018

NOTE: When using a CRF to initiate and track an OSR/TSR revision, mark Blocks 5, 6, and 9 as N/A.

3. Affected Text Sections, Tables, and/or Figures:
   E: 1.1, E: 4.4.5.1, 1.7.2, Figure 1.1-1, 1.2, 2.3, 2.6, 1.5, Figure 2.11-2, 3.3, 2.1.2, 3.3.2.3, 3.3.2.3.2, 3.4.2.1.2, 3.4.2.1.3, 3.4.2.1.4, 3.4.2.1.5, 3.5, Table 3.6-6, 4.6.1, 4.5.2-2.3, Chapter 5 TOC: 5.5.2.17, 5.7, 5.7.2, 5.7.2.1.2, 5.7.2.1.3, 5.7.2.1.4, 5.7.2.3.4, 5.7.2.4.2, 5.7.2.4.4, 5.7.3 (new). 5.8, Chapter 8 TOC: 6.3.3, 6.3.11, 6.3.12, 6.3.17, 6.3.21 (new), 13.3.2, 17.3.1

4. Description of SBD Change:
   Revise Saltstone Facility Safety Basis (DSA) to integrate the Salt Waste Processing Facility (SWPF) into Liquid Waste (LW) Operations.

5. Reason for SBD Change:
   □ Annual Update □ DOE Revision Issue
   □ Plant Modification/Design Change □ Change to Procedure as described in SBD
   □ New/Revised Technical Information □ Typographical Error
   □ Safety Evaluation in support of TSR/OSR □ Other (Attach Technical Justification)

6. References (Example - DCP, PCR, Technical Justification):
   G-TC-H-00049, Rev. 2

7. Originating Approval:
   Originator: G. E. Dorfler Signature: Date: 23 Jan 2019
   Safety Doc. Mgr: C. D. Cope Signature: Date: 01.25.19

8. Review and Issue/Comment Resolution Completions: (Mark as N/R if the review was not required.)
   Design Authority Review: M. M. Potvin Completion Date: 1/29/2019
   Interdisciplinary Review: M. J. Hart Completion Date: 1/24/19
   Consistency Review: J. A. Fisher Completion Date: 23 Jan 2019

9. Technical Review and USQ Screening:
   Technical Review/USQ No.: N/A Date:

10. CRP / Revision Approvals: (Must be signed before further approvals):
    Safety Doc. Mgr: J. M. Bricker Signature: Date: 01.29.19
    Mgr. Design Authority: E. J. Freed Signature: Date: 1/29/19

11. FOSC Review/Approval:
    FOSC Chairman: B. E. L. M. Signature: Date: 1/24/19
    Implementation Checklist Required? □ Yes □ No
E.0 EXECUTIVE SUMMARY

This Documented Safety Analysis (DSA) report documents the Safety Basis (SB) for the Saltstone Facility at the Savannah River Site (SRS).

E.1 FACILITY BACKGROUND AND MISSION

E.1.1 FACILITY BACKGROUND

The Saltstone Facility (Z-Area) is permitted as two facility segments: the Saltstone Production Facility (SPF), which produces saltstone grout, and the Saltstone Disposal Facility (SDF), which consists of Saltstone Disposal Units (SDUs) used for the disposal of the saltstone grout. The Saltstone Facility is part of the Liquid Waste (LW) facilities. The Saltstone Facility is one portion of an integrated waste management and disposal system located at the SRS. This integrated system is designed to treat liquid waste generated and stored at the SRS and convert the waste into solid waste forms suitable for final disposal. The Saltstone Facility is a critical part of this system because it is used to treat and dispose of low-activity mixed liquid waste generated by other waste treatment facilities in the integrated system. The Saltstone Facility will be used to treat and safely dispose of more than 90% of the waste (by volume) that will be generated from the treatment of High Level Waste (HLW) presently stored in waste tanks. The Saltstone Facility primarily treats low-activity waste generated by the Effluent Treatment Project (ETP), the Modular Caustic Side Solvent Extraction Unit (MCU), and in the future, the Salt Waste Processing Facility (SWPF). These low-activity waste streams are transferred and stored in Tank 50H until they are pumped to the Saltstone Facility for treatment and disposal. Waste from other sources may also be transferred to Tank 50H for processing as long as the waste transferred to the Saltstone Facility meets the requirements of the Saltstone Facility Waste Acceptance Criteria (WAC) Program. These feed streams are the basis for the bounding salt solution radionuclide and chemical concentration tables provided in Chapter 3.

Radioactive startup of the Saltstone Facility was authorized by the Department of Energy (DOE) in 1990. From startup to 1998, almost 3 million gallons of mixed aqueous waste was disposed of as a non-hazardous, Low Level Waste (LLW) solid known as saltstone.

In 1990, SDU 4 was used for the disposal of LLW from Naval Fuel Material Facility (FMF) operations. The FMF waste consisted of approximately 10,000 55-gallon drums containing solidified chemical waste and low levels of uranium. Void spaces in the drums were filled with clean grout (non-radioactive) before disposal. The drums were then placed in SDU 4 Cell A and grouted in place with clean grout. The FMF waste was placed in the Z-Area SDUs for disposal in order to meet the requirements of a consent order from the South Carolina Department of Health and Environmental Control (SCDHEC).

In 1998, operations at the Saltstone Facility were suspended due to a decision to seek alternative processes to prepare HLW solution for the Defense Waste Processing Facility (DWPF) and low-activity waste for the Saltstone Facility. Processing of waste at the Saltstone Facility was restarted in April 2002.
E.1.2 FACILITY MISSION

The present mission for the Saltstone Facility is to treat and dispose of solutions containing low levels of radioactive and chemical contaminants from HLW treatment facilities. The Saltstone Facility is committed to managing operations in such a manner that the health and safety of the offsite Public, the site Collocated Worker (CW), the Facility Worker (FW), and the environment are protected.

E.2 FACILITY OVERVIEW

The Saltstone Facility consists of the SPF, which produces saltstone grout, and the SDF, which consists of SDUs used for disposal of the saltstone grout. The Saltstone Facility is located on a 140-acre site in Z-Area directly across Road F from the DWPF in S-Area and approximately 1-mile northeast of H-Area (see Figure 1.11-1). Low-activity wastewater to be processed into grout is pumped from Tank 50H to the SPF through an inter-area transfer line. The inter-area transfer line is also shared with the SWPF for SWPF to Concentration, Storage, and Transfer Facilities (CSTF) transfers. The Saltstone Facility layout is shown in Figure 2.11-1. The boundary between H-Area and the Saltstone Facility is at the inlet flange of the manual inter-area transfer isolation valve located within the Clean Cap Batch Tank (CCBT) enclosure.

The nearest SRS site boundary to the Saltstone Facility is approximately 6.2 miles (10 kilometers) to the north. Fencing encloses the facility and paved roads provide transport access.

The Saltstone Facility receives domestic water from the site-wide distribution system and electricity from the 13.8 kilovolt (kV) electrical power system. Fire protection, health protection, industrial hygiene (IH), emergency medical, and security services are all immediately available to Z-Area from other SRS organizations.

Chapter 2 of the DSA provides a facility description of the Saltstone Facility.

E.3 FACILITY HAZARD CATEGORIZATION

For the purpose of hazard categorization, the Saltstone Facility is considered as one facility. Based on the maximum salt solution inventory, the Saltstone Facility was determined to be a Nuclear Hazard Category 2 (HC-2) facility.

E.4 SAFETY ANALYSIS OVERVIEW

Fire, explosion, loss of confinement, direct radiological exposure, external hazards, and natural phenomena are potential initiating events for hazardous material releases and were evaluated in the hazard evaluation.

Potential hazards associated with operations involve transferring salt solution to the Saltstone Facility that exceeds the Saltstone WAC or transferring a volume of salt solution in excess of the assumed Material at Risk (MAR). Receiving transfers of salt solution that exceed the WAC or the MAR could result in the Saltstone Facility operating with greater than analyzed quantities of radionuclides and/or chemicals. The Saltstone Facility WAC Program was identified and determined to be a Technical Safety Requirement (TSR) Specific Administrative Control (SAC)
performing a Safety Significant (SS) function to protect the inventory input assumptions used in the hazard analysis. The supporting analyses for the process locations within the Saltstone Facility [SPF/SDF e.g., Building 210-Z process room, Salt Solution Receipt Tanks (SSRTs), Salt Feed Tank (SFT), SDUs] may be based on different parameters. However, the Saltstone Facility WAC Program is assumed to protect the most limiting values as outlined in Chapter 3. The SDU Fill Heights were also determined to be TSR SACs. Furthermore, several operating conditions were identified to protect the MAR assumptions in the Consolidated Hazard Analysis (CHA) which are controlled and implemented by the Concentration, Storage, and Transfer Facilities (CSTF) and the SWPF Safety Basis.

The concern for a release of volatiles from the grout as it was curing in the SDUs led to an analysis of an SDU explosion scenario, which was determined to be not credible based on the limited amount of volatiles that could be released and the physical configuration of the SDUs. In order to protect assumptions associated with flammable gas accumulation in the SDU vapor space which could lead to the explosion, SDU SACs that perform an SS function were selected and identified in Section 5.5, and the passive vents on top of SDUs 2, 3, 4, and 5 were designated as SS Design Features. All SDU passive vents allow diurnal breathing and vapor space displacement during grout pour operations in order to prevent the buildup of flammable gases in the vapor space.

The concern for a release of volatiles in the SSRTs led to an analysis of two SSRT explosion scenarios. The SSRT explosion scenarios were determined to have High chemical consequences to the Facility Worker (FW) and the Collocated Worker (CW). SSRT SACs that perform an SS function were selected to protect against an explosion caused by following a Tornado/High Wind Event or Seismic Event. The SSRT SACs are identified in Section 5.5.

The concern for loss of containment and fires in the SSRT Area and the Building 210-Z process room led to the analysis of additional Tornado/High Wind Event scenarios. The Tornado/High Wind Event scenarios were determined to have High chemical consequences to the CW. An SSRT SAC that performs an SS function was selected to protect against the High consequences from a loss of containment and fire caused by following a Tornado/High Wind Event. The SAC is identified in Section 5.5.

No Safety Class (SC) Structures, Systems, or Components (SSCs) were identified for the Saltstone Facility operations and no SS SSCs were identified in addition to those credited for the SDUs 2, 3, 4, and 5 explosion event.

The CHA is the basis for the controls identified to prevent occurrences and mitigate consequences of potential accidents involving radiological and chemical materials. Chapter 3 identifies specific measures enforced by TSR SACs, and programmatic Administrative Controls (ACs) and identifies facility/process controls for protection of the FW.

E.5 ORGANIZATIONS

The following discussion (and the organization descriptions found throughout this DSA) is representative of the Saltstone Facility organizational structure, but may not be accurate in presenting current group and/or individual titles.
E.5.1 LIQUID WASTE CONTRACTOR

Savannah River Remediation LLC (SRR) is the current Liquid Waste Contractor as of July 01, 2009. Washington Savannah River Company (WSRC), formerly Westinghouse Savannah River Company, was responsible for the management and operations of SRS from April 1, 1989 through June 30, 2009. Previously, E. I. du Pont de Nemours and Company managed the facilities since 1950. Management and operation of SRS is currently the responsibility of the Management and Operations (M&O) contractor, the LW contractor, and the SWPF contractor.

E.5.2 LW ORGANIZATION

LW is the parent organization of the Saltstone Facility. The LW organization is managed by its President. LW includes the following project organizations:

- Engineering
- Closure Projects (part of CSTF)
- Environmental, Safety, Health, and Quality Assurance (ESH&QA)
- Projects, Design and Construction
- Operations
  - DWPF (vitrification and Actinide Removal Process [ARP])/Saltstone
  - CSTF (F Tank Farm, H Tank Farm, ETP, MCU)

E.5.3 SALTSTONE FACILITY ORGANIZATION

The Facility Manager has the overall responsibility for managing the safe operation and maintenance of the Saltstone Facility, including modifications. The Facility Manager reports to the Director of DWPF and Saltstone Facility who reports to the Chief Operating Officer and Deputy Project Manager, who reports to the LW President and Project Manager. The LW organization is supported by Engineering, Maintenance, Quality Assurance and other support groups as necessary to safely manage the radioactive waste that is disposed of at the Saltstone Facility.

Key operations and technical related positions in the various departments of LW are staffed by personnel with technical degrees or several years of industrial experience, primarily in the nuclear industry. The education and experience requirements for personnel involved in the operation, maintenance, training, and technical support of the Saltstone Facility are based on DOE O 426.2 and have been established to ensure that only qualified personnel are selected and assigned to positions which have a functional impact on safety and reliability.

E.5.4 OUTSIDE SUPPORT ORGANIZATIONS

AECOM N&E Technical Services LLC (AECOM N&E TS) provides safety analysis services and other related safety activities as directed by LW. Saltstone Facility uses the M&O contractor for certain supporting activities and the security contractor for site security services. The following organizations within the M&O contractor support the LW contractor:
1.5.3 TORNADOES

Tornadoes are discussed in Section 1.4 of the SCPD (Ref. 2). The hazard and accident analysis related to high winds and tornadoes is included in Chapter 3.

1.5.4 OTHER NATURAL EVENTS

Lightning, excessive snow and/or rain, and extremes in temperature are discussed in Section 1.4 of the SCPD (Ref. 2). The Hazard Analysis (HA) in Chapter 3 considered lightning, snow, rain, and extreme temperatures.

1.6 MAN-MADE EXTERNAL ACCIDENT INITIATORS

1.6.1 TRANSPORTATION

Section 1.6 of the SCPD describes the transportation network and the location of airports and airspace within the general area of the SRS (Ref. 2). The HA in Chapter 3 considers vehicle/aircraft/helicopter crashes into the Saltstone Facility.

1.6.2 UTILITIES

There are no natural gas or oil pipeline networks in use at the SRS. Electrical transmission lines are discussed in Section 1.6.1.2 of the SCPD (Ref. 2). The HA in Chapter 3 considers the impacts from utilities.

1.7 NEARBY FACILITIES

The SCPD identifies nuclear, industrial, and military facilities within a 50-mile (80 km) radius of the SRS center that have potential safety importance to the SRS (Ref. 2).

1.7.1 NON-SRS NUCLEAR/INDUSTRIAL COMPLEX FACILITIES

There are two non-SRS nuclear facilities and two non-SRS non-nuclear facilities within 50 miles of SRS that are discussed in the SCPD (Ref. 2).

1.7.2 SRS NUCLEAR FACILITIES

This section discusses nuclear facilities that are in proximity to Z-Area and have safety implications for this area.

S-Area is located within 0.5 miles (0.8 km) of Z-Area. Risk to Z-Area safety because of S-Area operations is minimal.

J-Area is located within 0.5 miles (0.8 km) of Z-Area. Risk to Z-Area safety because of J-Area operations is minimal.

The Tritium Facilities are located within 1 mile (1.6 km) of Z-Area. Risk to Z-Area safety is minimal except for tritium releases.

The H Canyon facility is located within 1 mile (1.6 km) of Z-Area. Risk to Z-Area safety is minimal.
1.11 FIGURES

Figure 1.11-1  SRS Site Map
2.0 FACILITY DESCRIPTION

2.1 INTRODUCTION

This chapter describes the Saltstone Facility, the overall process, and major SSCs.

2.2 REQUIREMENTS

Chapter 2 was developed using the content, format, and graded approach guidelines outlined in the following documents:

- Title 10 Code of Federal Regulations (CFR) Part 830, Subpart B (Ref. 1)
- DOE Order 420.1C (Ref. 28)
- DOE-STD-3009-94 (Ref. 2)
- S/RID, SRR-RP-2009-00558 (Ref. 3)

For the Saltstone Facility structures, the structural requirements used were those in effect when the designs were first developed and approved. The structures were designed and constructed in accordance with applicable du Pont and SRS Engineering and Design Standards. These standards provide specific, detailed, and instructive information for the designer including references to national codes and standards (Ref. 3).

2.3 FACILITY OVERVIEW

The Saltstone Facility is permitted as two separate facilities: the Saltstone Production Facility (SPF), which produces saltstone grout; and the Saltstone Disposal Facility (SDF), which consists of Saltstone Disposal Units (SDUs) used for disposal of the saltstone grout. The Saltstone Facility is part of the Liquid Waste (LW) organization. The Saltstone Facility is one portion of an integrated waste management and disposal system located at the SRS. This integrated system is designed to treat HLW that was generated and stored at the SRS, and convert the waste into solid waste forms suitable for final disposal. The Saltstone Facility is a critical part of this system because it is used to treat and dispose of low-activity mixed liquid waste generated by other waste treatment facilities that are also part of the integrated system. The Saltstone Facility will be used to treat and safely dispose of more than 90% of the waste (by volume) that will be generated from the treatment of HLW presently stored in waste tanks. The Saltstone Facility primarily treats low-activity waste generated by the Modular Caustic Side Solvent Extraction Unit (MCU), the Effluent Treatment Project (ETP), and in the future, the Salt Waste Processing Facility (SWPF). Low-activity waste from these processes is stored in Tank 50H until it is pumped to the Saltstone Facility for treatment and disposal via the inter-area transfer line. The inter-area transfer line is also shared with the SWPF for SWPF to CSTF transfers. Low activity waste from other sources may also be transferred to Tank 50H for processing as long as the waste transferred to the Saltstone Facility meets the requirements of the Saltstone Facility Waste Acceptance Criteria (WAC) Program.
steady-state after system startup, salt solution is integrated into the process and IW is secured. During the grout production run, IW is used to periodically flush grout from the internal surfaces of the grout hopper and supplements flow to the mixer as a response to low salt solution flow. During process setback or shutdown, liquid feed to the mixer transitions to IW during extended feed. Extended feed allows grout to be removed from the process room while minimizing the addition of salt solution to the SDU. IW is also used after the grout production run for final process component flushing.

The CCBT provides mixing and storage capability for the IW system. IW is generated in the CCBT by mixing 50 wt% Sodium Hydroxide (NaOH) with a large quantity of PW to produce an alkaline solution (nominal pH 10 – 12.5). The 50 wt% NaOH is supplied by a centrifugal pump from the 310 gallon caustic storage tank. In the event that IW is not available, PW is available for flushing purposes from the Process Water Tank area. (Figure 2-11.9)

The CCBT is a cylindrical tank with a nominal operating capacity of 45,000 gallons and a capacity of approximately 50,392 gallons at overflow. The CCBT shell and roof are 3/8 inch thick and the bottom is ½ inch thick carbon steel. The CCBT has a diameter of 25 feet and a height of 14 feet. The tank bottom is sloped to form a low point on one side of the tank. A pump is provided on the tank to discharge the IW to the grout process and flush systems. An agitator is provided for mixing.

The CCBT, which is located immediately adjacent to the SFT and the 210-Z Process Building, is placed in a below grade concrete enclosure. The walls of the enclosure are 12-inch thick reinforced concrete. The bottom of the tank is approximately 6 feet below grade, which places the top of the CCBT approximately 8 feet above grade. The walls of the CCBT enclosure extend approximately 8 feet above grade, which places the top of the enclosure walls approximately even with the top of the CCBT. A steel platform is installed above the top of the CCBT to provide for equipment access. The floor of the enclosure is sloped to direct spillage or leakage into a sump. A sump pump is provided for transferring liquid into the SFT. The CCBT is vented to the Facility PVVS.

Details on the CCBT IW system are contained in Reference 5.

2.5.1.5 Salt Solution Feed

The SSRTs, or alternatively the SFT, receive low-activity waste (commonly referred to as salt solution) through a jacketed inter-area transfer line from Tank 50H. The inter-area transfer line is under the administrative control of H-Area Tank Farm Operations. The boundary between H-Area and Z-Area is the inlet flange to the manual, inter-area transfer isolation valve, V-0040, which is located at the east wall in the CCBT enclosure. The inter-area transfer line is shared with the SWPF for SWPF to Tank 50H transfers (see Figure 2.11-2). Residual Decontaminated Salt Solution (DSS) from SWPF may be transferred to Saltstone on subsequent Tank 50H to SPF transfers. Located between the transfer isolation valve V-0040 and the SSRTs/SFT are in-line flow elements used to verify the amount of salt solution received from Tank 50H. The SFT also receives drainage from the Facility PVVS, the Leachate Collection and Return System, the Drainwater Collection and Return System, the Process Building drains, and the Operations Building drains, including lab hoods, sinks, and decontamination showers.
Figure 2.11-2  Simplified Process Diagram
mechanisms (see Section 3.3.2.1.3). DMHg is contained in the salt solution and may also be formed from soluble mercury in the salt solution. Benzene may be released from salt solution due to decomposition of TPB and butanol may be released due to decomposition of the TBP. In addition, DSS salt solution from the MCU and SWPF waste streams contains Isopar® L, which can be released under certain conditions to produce flammable vapor. Other volatile chemicals may also be present in salt solution from Tank 50H including ammonia, isopropanol, butanol, NORPAR™ 13, and methanol (Ref. 88).

Additional volatile chemicals may be released from dry feeds when mixed with salt solution (e.g., ammonia, benzene, toluene, and xylene). The cement and slag have the potential to release ammonia due to the grinding agents used in their production. In addition, ammonia may be produced due to reactions between slag and salt solution. Organics and ammonia may also be released from the flyash when mixed with salt solution. To minimize the release of organics and ammonia from flyash, thermally beneficiated flyash is used. Thermally beneficiated flyash is treated by an industry process in which the flyash is heated to elevated temperatures and maintained at these temperatures for a defined period of time which removes the majority of the ammonia and other organics.

3.3.2.1.3 Hydrogen Generation

The hydrogen generation rate (HGR) for grout containing salt solution is calculated using the following methods (Refs. 88 and 90).

The radiolytic HGR for a given waste depends on the radiation dose to the waste, the presence of organics, and the concentration of any hydrogen scavengers that may be present. Free ions of nitrate (NO$_3$) and nitrite (NO$_2$) are scavengers that serve to decrease the overall hydrogen gas. To account for the scavenging effect of both of these ions, NO$_{eff}$, equal to the NO$_3$ ion concentration plus one-half the NO$_2$ ion concentration, is introduced. During the production of Saltstone grout, reactions between NO$_2$ ions and slag result in a reduction in the concentration of NO$_2$ ions in salt solution. Therefore, the NO$_{eff}$ shall be equal to the NO$_3$ concentration plus one-quarter the NO$_2$ ion concentration (Ref. 88).

The radiolytic HGR, $x_{RAD}$, at 25°C is calculated from the radioactive decay heat using the equation (Ref. 90):

$$x_{RAD} \text{ (ft}^3/\text{hr-gal}) = \left( R_{\beta/\gamma} H_{\beta/\gamma} + R_{\alpha} H_{\alpha} \right) / 10^6$$

Where:

- $R_{\beta/\gamma} = \text{amount of hydrogen generated per 10}\text{,}^6 \text{ BTU of heat added from beta or gamma decay (ft}^3/\text{10}\text{,}^6 \text{ BTU)}$
- $H_{\beta/\gamma} = \text{heat generated by beta and gamma decay (BTU/hr-gal)}$
- $R_{\alpha} = \text{amount of hydrogen generated per 10}\text{,}^6 \text{ BTU of heat added from alpha decay (ft}^3/\text{10}\text{,}^6 \text{ BTU)},$ and
- $H_{\alpha} = \text{heat generated by alpha decay (BTU/hr-gal)}$
Unmitigated Hazards Analysis

Based on the unmitigated frequency and consequence levels determined, each credible event was binned in frequency-consequence space to assess relative risk.

In the unmitigated hazard analysis conducted for the Saltstone Facility, certain initial conditions and assumptions were made that apply to the SB of the facility. These initial conditions and assumptions included the following:

- To conservatively calculate dose and exposure consequences, it was assumed that all radioactive and chemical species that could be present in the salt solution transferred from H-Area are at concentrations that exceed actual process concentrations expected. These concentrations are higher than the nominal concentrations expected to be processed during operations, and are controlled by the Saltstone WAC. The radionuclide concentrations used as the basis for STs in the radiological consequence dose analysis are presented in Table 3.6-6. The radionuclides listed in Table 3.6-6 are those radionuclides that contribute greater than or equal to 0.10% of the Inhalation Dose Potential. Chemical concentrations are listed in Table 3.6-7. The chemical concentrations were originally based on Reference 67, but have been revised where appropriate to reduce the concentrations of the given chemicals as shown in Reference 88. The chemical concentrations used as the basis for the consequences in the exposure analysis are thus equal to or greater than the chemical concentrations presented in Table 3.6-7. These concentrations are judged to be sufficiently conservative to account for the fact that the salt solution has minor constituents that are not specifically accounted for [i.e., small quantities (less than detection limits in liquid samples) of trace constituents] and/or has slight variations in the compound forms which the chemical constituents may take at a particular point in time. Effects on ST is marginal and further action is not required for these minor constituents.

- The Saltstone Facility WAC Program is assumed to protect limits on inhalation dose potential, chemical and radiological concentrations, fissile material concentrations, HGR, temperature, and concentrations of chemicals that contribute to flammability (e.g., ammonia, butanol, DMHg, Isopar® L, isopropanol, methanol, NORPAR™ 13, TPB, TBP). The supporting analyses for the process locations within the Saltstone Facility (e.g., SDUs, Building 210-Z process room, SSRTs) may be based on different parameters, as outlined below. However, the Saltstone Facility WAC Program is assumed to protect the most limiting values.

- The CSTF to SPF inter-area transfer line is also shared with the SWPF for SWPF to CSTF transfers. Prior to DSS transfers from SWPF to Tank 50H, the DSS must meet the requirements of the CSTF WAC as well as comply with the Saltstone Facility WAC Limits, and therefore any residual SWPF DSS remaining in the inter-area transfer line will be compliant with the Saltstone WAC Limits.

- Workers have the ability to react to obvious hazardous conditions and to evacuate. This, of course, invokes the assumptions that the workers are made aware of the conditions, are physically able to evacuate, and that an evacuation route is available during, or immediately following, the hazardous condition.

- Salt solution, due to its high pH, is considered a contact hazard to FWs, and as such, is considered a SIH.

- Potential locations for confined hydrogen were evaluated for the possibility that fragments resulting from an explosion in these locations may impact safety related
SSCs. Impact to FWs due to fragments resulting from a confined hydrogen explosion is considered a SIH.

- IW and 50 wt% NaOH, due to their high pH, are considered a contact hazard to FWs and are considered a SIH.

- The total amount of radioactive salt solution taken to be the maximum missing waste that contributes to the bounding MAR volume is 15,000 gallons. This is applicable to both the Tank 50H to SPF inter-area transfers (Tank 50H to SPE) and intra-area transfers. A MAR of 43,600 gallons is utilized as the inter-area transfer line spill volume of the future SWPF Decontaminated Salt Solution Hold Tank (DSSHT), which is larger than the maximum missing waste utilized for the current CSTF transfer spill volume. This item is a placeholder for when SWPF comes on line and will have an additional interface control with the safety basis change allowing SWPF operation.

- The CSTF NPH Response terminates Tank 50H to SPF transfer to protect the 15,000-gallon maximum missing waste assumption and a siphon break is established at Tank 50H following a Tank 50H to SPF transfer and following an SWPF to Tank 50H transfer.

- The SWPF NPH Response terminates the transfer to Tank 50H, limiting the potential spill from the SWPF DSSHT to the SPF to 43,600 gallons.

- The SFT agitator is incapable of operation and power to the agitator has been secured. The blades of the agitator are encased in grout and therefore the agitator cannot operate. There are no significant heat addition mechanisms within the SFT aside from the agitator; due to its inoperable status, the agitator cannot heat the waste and therefore does not affect the flammability of the SFT.

- If a new flammable species becomes evident, it shall be evaluated to determine its contribution to flammability of the SFT. If the evaluation result is less than or equal to 0.5%, no further action is required. A threshold of 0.5% is appropriate as it has minimal impact to overall results of Reference 151. Margin is provided in the analysis as the SFT is assumed to be at an elevated temperature and in an overflow condition, minimizing the vapor space. Based on these considerations, cumulative additions of species less than or equal to 0.5% of the Lower Flammability Limit (LFL) is not required. If the result is greater than 0.5%, the new flammable species is not considered to be within the existing safety analysis.

To allow for future processing, the SSRT CHA (Ref. 134) considered the receipt, transfer, and processing of salt solution based on processing Tank 50H salt solution with high Isopar\textsuperscript{®} L characteristics. Those characteristics are:

- Isopar\textsuperscript{®} L is limited to 87.5 parts per million (ppm)
  The SSRT flammability calculations use Isopar\textsuperscript{®} L units of 87.5 ppm, which provides a more conservative vapor space concentration than units of milligrams/Liter (mg/L).

- Butanol is limited to 0.75 + 0.28 (from the hydrolysis of 1 mg/L of TBP) = 1.03 mg/L

- Isopropanol is limited to 0.25 mg/L

- Methanol is limited to 0.25 mg/L and represents methanol from Tank 50H (0.05 mg/L) and 0.20 mg/L when configured for set retardant
- NORPAR™ 13 is limited to 0.75 mg/L
- Ammonia is limited to 200 mg/L for flammability analysis and 220 mg/L for consequence analysis
- Dimethyl mercury is limited to 1.1 mg/L

Benzene from the decomposition of TPB was not considered in the SSRT flammability analysis. TPB decomposes at temperatures above 75°C, well above the operating range of the SSRTs (Ref. 135).

If a new flammable species becomes evident, it shall be evaluated to determine its contribution to flammability of the SSRTs. If the evaluation result is less than or equal to 0.5%, no further action is required. A threshold of 0.5% is appropriate as it has minimal impact to overall results of Reference 135. Margin is provided in the analysis as the SSRTs are assumed to be at an elevated temperature and in an overflow condition, minimizing the vapor space. Based on these considerations, cumulative additions of species less than or equal to 0.5% of the LFL is not required. If the result is greater than 0.5%, the new flammable species is not considered to be within the existing safety analysis.

- The radiolytic HGR of salt solution is assumed to be 1.41E-08 ft³/hr/gal at 95°C. This is assumed to be a continuous release.
- The thermolytic HGR is evaluated at the waste temperature utilized in flammability analysis. This is assumed to be a continuous release.
- The initial temperature of the salt solution entering Saltstone is limited to 40°C based on the Saltstone Facility WAC.
- The bounding pump flow rate from the SSRTs is limited based on the SSRT transfer pump runout rate of 170 gpm.
- The bounding volume of grout per pour is limited by the grout pump bounding flow rate of 180 gpm.
- Operator rounds are taken daily to monitor processes (e.g., SSRT parameters).

Additionally, the initial conditions and assumptions for maximum missing waste, and CSTF NPH Response, and SWPF NPH Response apply (as listed above in the unmitigated hazard analysis conducted for the Saltstone Facility).
The flammability analysis of SDUs 3 and 6 supporting the HA (Refs. 109, 143) considered pouring of grout containing salt solution and dry feeds into an SDU based on the following parameters:

- The Saltstone Facility will conduct Low Isopar® L Operation. Low Isopar® L Operation is defined by the processing of Tank 50H salt solution with low Isopar® L characteristics. Those characteristics are:
  - Isopar® L is limited to \(11.875\) ppm

The SDU flammability calculations for (excluding SDUs 3 and 6) use Isopar® L units of \(11.875\) ppm, which provides a more conservative vapor space concentration than units of mg/L. For the remaining SDUs, SDUs 2 and 5 are operationally filled and will no longer be receiving radioactive grout, and SDU 4 is inactive and no longer capable of receiving grout from the SPF.

The Saltstone Facility is limited to Low Isopar® L Operation, but the SDU 6 flammability calculation evaluates an Isopar® L concentration of up to \(87.5\) ppm. This is in support of future Salt Waste Processing Facility (SWPF) operation.

- Benzene is limited to a total of \(4.15\) kg per SDU cell
- Ammonia is limited to \(200\) mg/L
- Other volatiles
  - Butanol is limited to \(0.75\) mg/L + \(0.28\) (from the hydrolysis of \(1\) mg/L of TBP) = \(1.03\) mg/L
  - Isopropanol is limited to \(0.25\) mg/L
  - Methanol is limited to \(0.25\) mg/L
  - NORPAR™ 13 is limited to \(0.75\) mg/L
  - TBP is limited to \(1\) mg/L. TBP unto itself is not flammable; however, hydrolysis will produce \(0.28\) mg/L of butanol per \(1\) mg/L of TBP

Sampling of Tank 50H for these other volatiles may exceed their limits individually. Using existing SDU flammability methodology, an engineering evaluation may be completed to demonstrate that the Composite Lower Flammability Limit (CLFL) of the SDU vapor space will not exceed \(95\)% at the time the SDU is at the peak percent of CLFL.

If a new flammable species becomes evident, it shall be evaluated to determine its contribution to flammability. If the evaluation result is less than or equal to \(0.5\)%, no further action is required. A threshold of \(0.5\)% is appropriate as it has minimal impact to overall results of References 109 and 143. Because of this minimal impact, allowance for cumulative additions of species less than or equal to \(0.5\)% of the LFL is not required. In addition, vapor space sampling of the SDUs historically demonstrates that there is only a marginal concentration of flammables in the vapor space. If the result is greater than \(0.5\)%, SDUs 3 and 6 shall be evaluated per Reference 109 and 143 respectively to ensure the peak CLFL remains below \(95\)% at the Maximum Grout Height (Ref. 109, 143). The evaluation may use actual
Several initial conditions are credited for the Saltstone Facility events as SS for protecting bounding initial conditions:

- The SDU Cell Passive Vents are required to ensure flammable gases do not accumulate in the SDU vapor space. The SDU Cell Passive Vents provide a connection between the SDU vapor space and environment that allows the displacement of vapor space volume during pouring and passive breathing, which reduces the accumulation of flammable gases in the SDU vapor space. This Design Feature (DF) will perform an SS safety function. SDU 6 passive vents are excluded (but are still protected by the Structural Integrity Program discussed below) based on the conclusions of Reference 142.

- The CSTF NPH Response shall ensure during a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, the Tank 50H to SPF transfers are terminated and a siphon break established at Tank 50H. Additionally, following termination of an SWPF to Tank 50H transfer, a siphon break is established at Tank 50H. Securing the Tank 50H to SPF Z-Area transfer protects the initial conditions of the accident analysis by limiting the potential spill volume from a Tank 50H to SPF transfers to 15,000 gallons. These transfers are secured in mitigated non-seismic event progressions. Establishing the siphon break prevents a siphon from Tank 50H to the SPF. This interface control will perform an SS safety function.

- The SWPF NPH Response shall ensure during a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, the SWPF to Tank 50H transfer is terminated. Securing the SWPF to Tank 50H transfer protects the initial conditions of the accident analysis by limiting the potential spill due to a potential loss of piping integrity at the SPF to the volume of the SWPF DSSHT. This transfer is secured in mitigated non-seismic event progressions. This interface control performs an SS safety function.

- The Saltstone Facility WAC Program shall ensure that the composition of the salt solution received from Tank 50H is within the analyzed limits. This safety function is accomplished by maintaining a material balance to ensure compliance with the Saltstone WAC. Salt solution transfers are within analyzed flammability limits provided the HGR (radiolytic and thermolytic) and concentration of chemicals that contribute to the flammable vapor constituents (e.g., ammonia, butanol, DMHg, Isopar® L, isopropanol, methanol, NORPAR™ 13, TBP, TPB), and the temperature of the salt solution remains at or below 40°C prior to transfer are protected. This program will perform an SS safety function. This control is not applicable to SDUs 2, 4, and 5. SDUs 2 and 5 are operationally filled and SDU 4 is inactive. The grout transfer line has been blanked to SDUs 2 and 5 and is no longer connected to SDU 4.

- The SDU Fill Heights shall ensure that the SDU vapor space is maintained below the CLFL. This safety function is accomplished by limiting the height to which an operationally active SDU can be filled with grout that maintains a minimum vapor space volume, which allows the bulk vapor space to remain below the CLFL. These SACs will perform an SS safety function. This control is not applicable to SDUs 2, 4, and 5. SDUs 2 and 5 are operationally filled and SDU 4 is inactive. The grout transfer line has been blanked to SDUs 2 and 5 and is no longer connected to SDU 4.

- The Structural Integrity Program shall ensure the function of the SDU Cell Passive Vents (SDUs 2, 3, 4, and 5) and SDU passive vents (SDU 6). This safety function is accomplished by periodic inspection of the passive vents in order to identify if any structural degradation or pluggage is occurring, which may compromise the ability of the passive vents to perform their function. This program will perform an SS safety function.
• The Prohibited Operations Program protects the present inventory and vapor space volume of an SDU/SDU cell and forms the basis for the hazards analysis. Additional inventory is prevented from entering inactive/operationally filled SDUs/SDU cells for all possible configurations. Flammability of the vapor space in an SDU/SDU cell has a direct correlation to the available vapor volume and the amount of flammable materials that enter the SDU/SDU cell. This program will perform an SS safety function.

Multiple CHAs (Ref. 6, 112, 123, 134, 142), when considered in aggregate, constitute the HA for the Saltstone Facility. For Low Isopar® L Operation, an explosion in the vapor space of an SDUs 3 and 6 is not credible due to the initial conditions credited. For the remaining SDUs, SDUs 2 and 5 are operationally filled and will no longer be receiving radioactive grout, and SDU 4 is inactive and no longer capable of receiving grout from the SPF. Some CHAs assume that Saltstone is processing salt solution with high Isopar® L characteristics; however, the Saltstone Facility is limited by the Saltstone Facility WAC Program to Low Isopar® L Operations only. The conclusions of these CHAs do not change if processing salt solution with low Isopar® L characteristics.

The results of the unmitigated hazard analysis are documented in the CHAs (Ref. 6, 112, 123, 134, 142). Five unmitigated events from the SSRT CHA and the SDU 6 CHA exceed the risk criteria for chemical guidelines to the CW receptor (Ref. 134 and 142). No other unmitigated events exceed the risk criteria for radiological consequences or chemical guidelines to the CW or Public receptor. Many events are binned into Region B (Moderate consequences) for the CW and FW receptor due to exceeding the chemical consequences of the Protective Action Criteria 2 (PAC-2). The Region B events for the CW and FW are summarized in the CHAs (Ref. 6, 112, 123, 134, 142). No events were determined to challenge the radiological EGs for the Public receptor.

Mitigated Hazard Analysis

There were a number of other events where the chemical concentrations calculated for the CW exceeded the PAC-2 values and required further evaluation in the mitigated analysis. The results of the mitigated analysis are documented in the CHAs (Ref. 6, 112, 123, 134, 142).

3.3.2.3.1 Planned Design and Operational Safety Improvements

There are no design or operational safety improvements resulting from the hazards analysis performed that are not yet implemented.

3.3.2.3.2 Defense In Depth

DID, as an approach to facility safety, builds in layers of defense against the release of hazardous and radiological material so that no one layer is completely relied upon. To compensate for potential human and mechanical failures, DID is based on several layers of protection with successive barriers to prevent the release of hazardous materials to the environment. This approach includes measures to protect the public, site worker, and the environment from harm in case these barriers are not fully effective.
Safety-Significant SSCs

Based on the SSRT CHA (Ref. 134) and the SDU 6 CHA (Ref. 142), five unmitigated events were determined to have the potential for High onsite chemical consequences. These events are controlled through SACs. Based on the CHAs, no other unmitigated events were determined to have the potential for High consequences, which would require SS SSCs. The SDU Cell Passive Vents, which are considered an initial condition, are classified as SS DFs for all SDUs except SDU 6.

TSRs

Based on the SSRT CHA (Ref. 134) and the SDU 6 CHA (Ref. 142), five unmitigated events were determined to have the potential for High onsite chemical consequences, which are controlled through SACs. These SACs include securing the SSRT agitator(s) prior to a Tornado/High Wind Event and following a Seismic Event and securing transfers from the SSRT(s) and SFT prior to a Tornado/High Wind Event. Based on the other CHAs (Ref. 6, 112, 123), no other unmitigated events were determined to require TSRs. The Saltstone Facility WAC Program and the SDU Fill Heights, which are considered initial conditions, are classified as SACs.

In addition, the Saltstone Facility CHA assumed a maximum of 15,000 gallons salt solution as missing waste volume during intra-area transfers and a maximum of 43,600 gallons DSS from a siphon/drain down of the SWPF DSSHT. In order to protect this volume, programmatic and/or SACs shall ensure that inadvertent transfers, including a siphon from Tank 50H, are prevented. Section 5.7, “Interface with TSRs from Other Facilities”, identifies controls to ensure that the inventory input and MAR assumptions related to the Saltstone Facility remain valid and that waste received does not exceed the HA assumptions.

Chapters 4 and 5 provide additional detail with respect to programmatic and specific ACs, interface with TSRs from other facilities, and credited controls.

3.3.2.3.3 Worker Safety

This section summarizes the efforts for identification of major features protecting workers from the hazards of facility operation. The HA process identified facility/process controls that provide additional worker protection for Region A and B events for the FWs. These facility/process controls are listed in the CHA (Ref. 6, 112, 123, 134, 142) for postulated radiological/chemical events. Facility and site programs, which protect the worker, are outlined in Chapters 7-17. Safety management programs that are addressed by TSR ACs are discussed in Chapter 5.

3.3.2.3.4 Environmental Protection

The potential for large material releases to the environment is minimized by the facility/process controls that were identified during the HA process. These facility/process controls protect the public, workers, and the environment. In addition to these facility/process controls, additional controls designed to protect the environment are discussed below.
challenge the offsite guideline require SC mitigation. Those exceeding the onsite guideline require SS mitigation.

The offsite and onsite (100 m) chemical exposure guidelines are the PAC-2 and PAC-3 concentration limits, respectively, given in Reference 41. Consequences calculated to exceed the onsite or the offsite chemical guideline require SS mitigation.

3.4.2 DESIGN BASIS ACCIDENTS

The DBAs for the Saltstone Facility are in the natural phenomena events category (i.e., Tornado/High Wind and Seismic Events). The consequences in this section are quantified based on salt solution with high Isopar® L characteristics as described in Section 3.3.2.3.

3.4.2.1 Tornado/High Wind Event

3.4.2.1.1 Scenario Development

The Tornado/High Wind Event results in several potential accident scenarios. The first scenario involves an SSRT explosion, the second scenario involves multiple spills and fires occurring in the Saltstone Facility (Saltstone Full Facility Event), the third scenario involves multiple spills and fires occurring in the SSRT area, and the last scenario involves a spill and fire in the Building 210-Z process room.

Tornado/High Wind Event (SSRT Explosion Scenario)

This event scenario addresses a detonation of the SSRT due to the presence of flammable vapors in the vapor space. The resulting explosion fails the tank and hazardous material is released to the environment.

The HA classifies this event in the Anticipated frequency bin (unmitigated). No detailed frequency analyses were performed to lower the assumed frequency. Though not credited, normal operating procedures and the low probability of an ignition source being present with the vapor space above 100% of the CLFL significantly reduce the probability of an SSRT explosion.

The unmitigated accident progression involves the following:

- SSRT agitator is running with salt solution processing in progress
- Tornado/High Wind Event occurs causing salt solution transfers into and out of the SSRT to stop, leaving the SSRT stagnant
- SSRT agitator continues to run for greater than ~108 hours (Ref. 137)
- SSRT agitator running causes salt solution temperature to increase to 55°C (Ref. 137)
- Flammable vapors accumulate in the SSRT vapor space exceeding CLFL and ignite (ignition source is assumed present)
- Explosion breaches the SSRT and spills tank contents
The mitigated accident progression involves the following:
- SSRT agitator is running with salt solution processing in progress
- Tornado warning or high wind warning issued by SRS Operations Center (SRSOC)
- Severe Weather Response Program [First Level of Control (LOC)] secures SSRT agitator(s) operation upon a tornado warning or high wind warning (SAC)

Since the agitator is the main source of heat input into the SSRTs, the Severe Weather Response Program prevents the SSRT explosion by removing the heat source. Given the time required to reach CLFL due to heating the SSRT and that the required action occurs prior to the event, the Tornado/High Wind induced SSRT explosion is prevented. No mitigated analysis is required.

Tornado/High Wind Event (Full Facility Spills and Fires Scenario)

This event scenario addresses multiple spills and fires throughout the Saltstone Facility occurring simultaneously. The resulting event releases hazardous material to the environment.

This scenario includes an initial condition that the SSRT discharge piping to the Building 210-Z process room includes a non-safety related gravity drain pipe loop with siphon break assembly that by its passive design and configuration prevents a siphon from the SSRTs to the Building 210-Z process room.

The HA classifies this event in the Anticipated frequency bin (unmitigated). No detailed frequency analyses were performed to lower the assumed frequency.

The unmitigated accident progression involves the following:
- Salt solution processing in progress
- Tornado/High Wind Event occurs damaging the Saltstone Facility leading to spills and fires involving salt solution and grout
- Spill or loss of confinement occurs from the inter-area transfer line, SFT to SSRT transfer line, SSRT to mixer transfer line, SSRT, Building 210-Z process room hold-up MAR, SPF and SDU HEPA filters, SDU vapor, SDU 6 unset grout, leachate collection and return system, and the SDU 6 drainwater collection and return system
- Fire occurs in the CCBT enclosure, Building 210-Z process room, and SPF and SDU HEPA filters

The mitigated accident progression involves the following:
- Salt solution processing in progress
- Tornado warning or high wind warning issued by SRSOC
- Severe Weather Response Program (First LOC) secures transfers from the SSRT(s) and SFT upon a tornado warning or high wind warning (SAC)
- CSTF Transfer Termination and Isolation During/Following NPH Events terminates transfers from CSTF and establishes a siphon break at Tank 50H upon a tornado watch/tornado warning/high wind warning. Additionally, following termination of an SWPF to Tank 50H transfer, a siphon break is established at Tank 50H (SAC)
- SWPF Transfer Termination and Isolation During/Following NPH Events terminates SWPF to CSTF transfer upon a tornado watch/tornado warning/high wind warning (SAC)
Tornado/High Wind Event occurs damaging the Saltstone Facility leading to spills and fires involving salt solution and grout

- Spill or loss of confinement occurs from the SFT, both SSRTs, Building 210-Z process room hold-up MAR, SPF and SDU HEPA filters, SDU vapor, SDU 6 unset grout, SDU 6 drainwater, and leachate collection and return system

- Fire occurs in the Building 210-Z process room and SPF and SDU HEPA filters

Since most of the ST for the event is from the spills and fires in the Building 210-Z process room and CCBT enclosure, the Severe Weather Response Program, and CSTF NPH Response, and SWPF NPH Response are pre-event actions that will significantly reduce the consequences by limiting the MAR involved. The spill from transferring drainwater to the SFT does not occur in mitigated analysis since the SFT is assumed full; however, it is assumed damage occurs to SDU 6 resulting in a drainwater spill from it.

**Tornado/High Wind Event (SSRT Area Spills and Fires Scenario)**

This event scenario addresses multiple spills and fires in the SSRT Area occurring simultaneously. The resulting event releases hazardous material to the environment.

This scenario includes an initial condition that the SSRT discharge piping to the Building 210-Z process room includes a non-safety related gravity drain pipe loop with siphon break assembly that by its passive design and configuration prevents a siphon from the SSRTs to the Building 210-Z process room.

The HA classifies this event in the Anticipated frequency bin (unmitigated). No detailed frequency analyses were performed to lower the assumed frequency.

The unmitigated accident progression involves the following:

- Salt solution processing in progress
- Tornado/High Wind Event occurs damaging the Saltstone Facility leading to spills and fires involving salt solution and grout
- Spill or loss of confinement occurs from the inter-area transfer line, SFT to SSRT transfer line, SSRT to mixer transfer line, SSRT, and Building 210-Z process room hold-up MAR
- Fire occurs in the CCBT enclosure and Building 210-Z process room

The mitigated accident progression involves the following:

- Salt solution processing in progress
- Tornado warning or high wind warning issued by SRSOC
- Severe Weather Response Program (First LOC) secures transfers from the SSRT(s) and SFT upon a tornado warning or high wind warning (SAC)
- CSTF Transfer Termination and Isolation During/Following NPH Events terminates transfers from CSTF and establishes a siphon break at Tank 50H upon a tornado watch/tornado warning/high wind warning. Additionally, following termination of an SWPF to Tank 50H transfer, a siphon break is established at Tank 50H (SAC)
- SWPF Transfer Termination and Isolation During/Following NPH Events terminates SWPF to CSTF transfer upon a tornado watch/tornado warning/high wind warning (SAC)
- Tornado/High Wind Event occurs damaging the Saltstone Facility leading to spills and fires involving salt solution and grout
- Spill or loss of confinement occurs from the SFT, both SSRTs, and Building 210-Z process room hold-up MAR
- Fire occurs in Building 210-Z process room

Since most of the ST for the event is from the spill and fire in the Building 210-Z process room, the Severe Weather Response Program, and CSTF NPH Response, and SWPF NPH Response are pre-event actions that will significantly reduce the consequences by limiting the MAR involved.

Tornado/High Wind Event (Building 210-Z Process Room Spill and Fire Scenario)

This event scenario addresses a spill and fire in the Building 210-Z process room. The resulting event releases hazardous material to the environment.

This scenario includes an initial condition that the SSRT discharge piping to the Building 210-Z process room includes a non-safety related gravity drain pipe loop with siphon break assembly that by its passive design and configuration prevents a siphon from the SSRTs to the Building 210-Z process room.

The HA classifies this event in the Unlikely frequency bin (unmitigated). No detailed frequency analyses were performed to lower the assumed frequency.

The unmitigated accident progression involves the following:
- Salt solution processing in progress
- Tornado/High Wind Event occurs damaging the Saltstone Facility leading to spill and fire involving salt solution and grout
- Spill or loss of confinement occurs from the SFT or SSRT to mixer transfer line and Building 210-Z process room hold-up MAR
- Fire occurs in the Building 210-Z process room

The mitigated accident progression involves the following:
- Salt solution processing in progress
- Tornado warning or high wind warning issued by SRSOC
- Severe Weather Response Program (First LOC) secures transfers from the SSRT(s) and SFT upon a tornado warning or high wind warning (SAC)
- Tornado/High Wind Event occurs damaging the Saltstone Facility leading to spill and fire involving salt solution and grout
- Spill or loss of confinement occurs from the Building 210-Z process room hold-up MAR
- Fire occurs in the Building 210-Z process room
Since most of the ST for the event is from the spill and fire in the Building 210-Z process room, the Severe Weather Response Program is a pre-event action that will significantly reduce the consequences by limiting the MAR involved.

3.4.2.1.2 Source Term Analysis

Offsite and Onsite ST and dose calculations are based on the methodologies discussed in Section 3.4.1. For chemical consequence analysis, salt solution equivalent volumes are converted to actual volumes of salt solution and grout for evaluation.

**Tornado/High Wind Event (SSRT Explosion Scenario)**

The following inputs and assumptions were used to determine the SSRT explosion ST and are taken from References 136, 137, and 138:

- Salt solution temperature maintained ≤ 40°C
- Maximum salt solution volume in the SSRT is 65,500 gallons
- SSRT agitator is 15 horsepower with an 85% efficiency
- ARF*RF for aqueous spills < 3 meters is 1E-04
- ARR*RF for aqueous spill resuspension is 4E-06/hr
- LPF is 1.0

The volume of salt solution in the SSRT when the explosion occurs also contributes to the total ST by spilling onto the ground and being resuspended. This spill and resuspension ST is summed with the explosion ST to determine a total ST for the Tornado/High Wind Event (SSRT Explosion Scenario). For short duration events (explosions) in chemical analysis, resuspension is insignificant since the duration is only 15 minutes. A parametric analysis based on SSRT liquid level was performed to determine the bounding total ST.

**Tornado/High Wind Event (Full Facility Spills and Fires Scenario)**

The following inputs and assumptions were used to determine the full facility spill and fire STs and are taken from References 138, 139, and 142:

- DSSSalt solution volume from the inter-area transfer line is 43,600 gallons
- Salt solution volume from an SSRT spill into the process enclosure is 9,658 gallons
- Salt solution volume in SFT is 6,504 gallons
- Salt solution volume in one SSRT is 65,500 gallons
- Salt solution volume from the SSRT to mixer transfer line is 15,000 gallons

---

1The inter-area transfer line spill is the volume of the future SWPF Decontaminated Salt Solution Hold Tank (DSSH), which is larger than the maximum missing waste utilized for the current CSTF transfer spill volume. This item in the progression is a placeholder for when SWPF comes on line and will have an additional interface control with the safety basis change allowing SWPF operation.
Tornado/High Wind Event (SSRT Area Spills and Fires Scenario)

The following inputs and assumptions were used to determine the SSRT area spills and fires STs and are taken from References 138 and 139:

- **DSS** salt solution volume from the inter-area transfer line is 43,600 gallons\(^2\)
- Salt solution volume from an SSRT spill into the process enclosure is 9,658 gallons
- Salt solution volume in SFT is 6,504 gallons
- Salt solution volume in one SSRT is 65,500 gallons
- Salt solution volume from the SSRT to mixer transfer line is 15,000 gallons
- Salt solution volume in Building 210-Z process room hold-up is 375 gallons
- ARF*RF for aqueous spills < 3 meters is 1E-04
- ARF*RF for inter-area transfer line spill > 3 meters is 4.1E-04
- ARF*RF for SFT to SSRT aqueous spills > 3 meters is 2.4E-04
- ARF*RF for process room aqueous spills > 3 meters is 1.1E-04
- ARR*RF for aqueous spill resuspension is 4E-06/hr
- ARF*RF for boiling of aqueous spills is 2E-03
- ARF*RF for boiling to dryness of aqueous spills is 5.6E-03
- ARF*RF for heating of waste during a fire is 3E-05
- ARR*RF for post-fire powder resuspension is 4E-05/hr
- ARF*RF for viscous spill (grout) < 3 meters is 5.6E-06
- ARF*RF for aqueous spill ≤ 1 meter is 2E-05
- LPF is 1.0

The various spill and fire STs along with applicable resuspension STs are summed together to determine a total ST for the Tornado/High Wind Event (SSRT Area Spills and Fires Scenario).

Tornado/High Wind Event (Building 210-Z Process Room Spill and Fire Scenario)

The following inputs and assumptions were used to determine the Building 210-Z process room spills and fires STs and are taken from References 138 and 140:

- Salt solution volume from the SSRT or SFT to mixer transfer line is 15,000 gallons (6,504 gallons for SFT)

\(^2\)The inter-area transfer line spill is the volume of the future SWPF DSSHT, which is larger than the maximum missing waste utilized for the current CSTF transfer spill volume. This item in the progression is a placeholder for when SWPF comes on line and will have an additional interface control with the safety basis change allowing SWPF operation.
3.4.2.1.5 Summary of Controls

In addition to the initial condition controls stated in Section 3.3.2.3, the following SS controls are required to ensure that the consequences of a Tornado/High Wind Event does not exceed the Onsite EGs and also to further reduce the associated risk (as discussed earlier in the mitigated accident progression).

The following controls performs an SS safety function:

*Severe Weather Response Program:*

The Severe Weather Response Program is a SAC to perform the following functions:

- Secure transfers from the SSRT(s) and SFT upon a tornado warning or high wind warning
- Secure SSRT agitator(s) operation upon a tornado warning or high wind warning

*CSTF Transfer Termination and Isolation During/Following NPH Events:*

The CSTF Transfer Termination and Isolation During/Following NPH Events is a SAC to perform the following functions:

- Terminate transfers from CSTF and establish a siphon break upon a tornado watch/tornado warning/high wind warning (SAC)

3.4.2.2 Seismic Event

The Seismic Event results in a potential SSRT explosion.

3.4.2.2.1 Scenario Development

*Seismic Event (SSRT Explosion Scenario)*

This event scenario addresses a detonation of the SSRT due to the presence of flammable vapors in the vapor space. The resulting explosion fails the tank and hazardous material is released to the environment.

The HA classifies the Seismic Event (SSRT Explosion Scenario) in the Unlikely frequency bin (unmitigated) based on the Seismic Event only. No detailed frequency analyses were performed to lower the assumed frequency. Though not credited, normal operating procedures and the low probability of an ignition source being present with the vapor space above 100% of the CLFL significantly reduce the probability of an SSRT explosion.

The unmitigated accident progression involves the following:

- SSRT agitator is running with salt solution processing in progress
- Seismic Event occurs causing salt solution transfers into and out of the SSRT to stop, leaving the SSRT stagnant
- SSRT agitator continues to run for greater than ~108 hours (Ref. 137)
INSERT A:

**CSTF NPH Response:**

The CSTF NPH Response is a SAC to perform the following functions:

- Terminate Tank 50H to SPF transfer and establish a siphon break at Tank 50H upon a tornado watch/tornado warning/high wind warning (SAC)
- Following termination of an SWPF to Tank 50H transfer, establish a siphon break at Tank 50H (SAC)

**SWPF NPH Response:**

The SWPF NPH Response is a SAC to perform the following functions:

- Terminate SWPF to Tank 50H transfer upon a tornado watch/tornado warning/high wind warning (SAC)
139. Saltstone Chemical Consequence Analysis for Natural Phenomena Hazards (U). S-CLC-Z-00096, Rev. 2.


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

146. Deleted


150. Hope, E., Unit Total Effective Dose Factors for Onsite and Offsite Receptors at SRS (U). S-CLC-G-00372, Rev. 3.

151. Saltstone SFT Tank Flammability Analysis (U). S-CLC-Z-00055, Rev. 3.
Table 3.6-6  Salt Solution Radionuclide Waste Stream Summary

<table>
<thead>
<tr>
<th>Radionuclide (1)</th>
<th>Decay Type (α, β/γ)</th>
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<td>Co-60</td>
<td>β/γ</td>
<td>4.73E-03</td>
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<tr>
<td>Sr-90</td>
<td>β/γ</td>
<td>3.97E-02</td>
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<tr>
<td>Y-90</td>
<td>β/γ</td>
<td>3.97E-02</td>
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<tr>
<td>Tc-99</td>
<td>β/γ</td>
<td>1.78E-02</td>
</tr>
<tr>
<td>Ru-106</td>
<td>β/γ</td>
<td>4.73E-03</td>
</tr>
<tr>
<td>Cs-137</td>
<td>β/γ</td>
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</tr>
<tr>
<td>Pm-147</td>
<td>β/γ</td>
<td>2.37E-02</td>
</tr>
<tr>
<td>Eu-154</td>
<td>β/γ</td>
<td>9.46E-03</td>
</tr>
<tr>
<td>U-232</td>
<td>α</td>
<td>3.43E-05</td>
</tr>
<tr>
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<tr>
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<td>α</td>
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<td>U-238</td>
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<td>4.73E-05</td>
</tr>
<tr>
<td>Pu-241</td>
<td>β/γ</td>
<td>3.52E-03</td>
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<tr>
<td>Total α (3)</td>
<td>α</td>
<td>1.01E-03</td>
</tr>
</tbody>
</table>

Notes:
1. Radionuclides that are major contributors to radiological dose. These are radionuclides that contribute 0.10% or greater of the inhalation dose potential (Ref. 88).
2. Bounding concentrations are taken from Reference 88.
3. Total α bounds all those alpha-emitting radionuclides that are transuranic (TRU) radionuclides. The Total α from the SWPF waste steam is bounded by the Total α concentration from ARP/MCU (Ref. 148). TRU waste is defined as waste containing more than the total alpha NRC Class C concentration of 100 nCi/g including those alpha-emitting radionuclides having an atomic number greater than 92, and a half-life longer than 5 years. The Total α limit cannot be exceeded because TRU waste is not allowed to be disposed of at the Saltstone Disposal Facility (SDF). For all the radionuclides contributing to the Total α limit, Pu-239 is selected because it has the highest DCF of the TRU isotopes expected to be present in significant quantities.
Additionally, the WAC Program shall ensure the temperature of the salt solution is within DSA analyzed limits.

Concentrations of butanol, isopropanol, methanol, TBP, and NORPAR™ 13 may be exceeded provided that their cumulative contribution to flammability from all five remains less than or equal to the cumulative value from all five originally determined using methodologies described in Chapter 3 or supporting calculations and they do not exceed the concentrations assumed for chemical consequences. This analysis, when appropriate, may use historical data to demonstrate compliance.

4.5.1.4 SAC Evaluation

The parameters limited by the WAC protect bounding assumptions used in the Saltstone Facility accident analysis.

- The Inhalation Dose Potential Limit of ≤ 2.26E+05 rem/gallon is based upon the cumulative sum of a mixture of radionuclide Dose Conversion Factors multiplied by the bounding radionuclide concentrations for the radionuclides that contribute 0.10% of the Inhalation Dose Potential or greater (Ref. 15). The bounding radionuclide concentrations, shown in Table 3.6-6, were derived from an analysis of the actual concentrations of radionuclides in the CSTF tanks expected to be sent to the Saltstone Facility. The bounding radionuclide concentration values were used in the consequence calculations in the accident analysis. The Saltstone Facility WAC Program ensures that the bounding Inhalation Dose Potential Limit is not exceeded. Verification of the material balance report ensures transfers to the Saltstone Facility do not exceed WAC limits, providing assurance that the consequences determined in the accident analysis will remain bounding.

- The inhalation dose potential of the most significant radionuclides that contribute more than 99% to the DSA limit are characterized by engineering prior to each transfer into Tank 50H. This characterization is based on sampling and analysis (accounting for analytical uncertainty as described in Section 4.5.1.2) or process knowledge. A material balance report of the Tank 50H characterization, which is derived from the CSTF Waste Characterization System, is issued periodically (typically on a monthly basis) by Liquid Waste Engineering in which the concentrations of the most significant radionuclides are verified to be below their limits. The cognizant Saltstone technical function reviews and approves the report before it is issued. Periodic samples are also taken from Tank 50H to confirm compliance with the Saltstone WAC the material balance.

- The Saltstone Facility WAC Program shall ensure the salt solution assumptions associated with flammability used in this DSA remain valid. Contributors to flammability of particular concern are benzene, Isopar® L, ammonia, hydrogen, and other flammable volatiles.

The total mass of TPB received into the Saltstone Facility shall be limited to ensure that no more than 4.15 kg of benzene can be generated. Benzene postulated to be in the salt solution was due to TPB from Tank 50H. As described in Section 3.3.2.1, the estimated amount of TPB determined to be in the CSTF tanks, excluding that in Tank 48H, is 4.76 kg in the form of KTPB. This amount of KTPB is contained in Tank 50H and can generate a
maximum of 4.15 kg of benzene. Further additions of TPB to Tank 50H shall be prohibited. In addition, the transfer of Tank 48H material to the Saltstone Facility shall be prohibited to ensure the DSA limit on TPB received at the Saltstone Facility is not exceeded.

The ammonia concentration in salt solution shall be limited to less than or equal to 200 mg/L. The contribution from ammonia to CLFL is based on the contribution from the salt solution, dry feeds, and chemical reactions. Maintaining the ammonia concentration in salt solution less than 200 mg/L is required to prevent exceeding the assumed contribution to CLFL.

The radiolytic HGR shall be limited to 1.41E-08 ft³/hr/gal of salt solution in grout at 95°C. The Saltstone Facility WAC Program shall ensure this radiolytic HGR is not exceeded using methodology described in Section 3.3.2.1, Hazard Identification. The radiolytic HGR is based upon the radionuclides that contribute 0.10% of the HGR or greater (Ref. 10).

The TOC, aluminum, and density of salt solution shall be limited to ensure the thermolytic HGR calculated in support of flammability analysis is not exceeded. The combined TOC and aluminum contribution within salt solution shall be limited to less than or equal to 0.05 wt%.

At Isopar® L concentrations up to 1187.5 ppm, the vapor space of SDUs 3 and 6 remains below the CLFL (Ref. 29, 44). SDUs 2 and 5 are operationally filled and will no longer be receiving radioactive grout, and SDU 4 is inactive and no longer capable of receiving grout from the SPF. Although SDU 6 is designed and analyzed to accept up to 87.5 ppm Isopar® L while maintaining the vapor space below CLFL (Ref. 44), Therefore, the current WAC limits Isopar® L concentrations to no greater than 1187.5 ppm.

Due to limited process knowledge, representative sampling and analysis of DSS at SWPF shall occur prior to transfer from SWPF to Tank 50H to verify DSS compliance with the CSTF WAC as well as with Saltstone WAC Limits, as required in the CSTF WAC. and sampling capabilities associated with very low Isopar® L concentrations, the following non-SAC items shall be implemented by the CSTF as described in Reference 30:

- A blend calculation shall be performed to specify the allowable total volume of Decontaminated Salt Solution (DSS) that is authorized for transfer from MCU to Tank 50H to ensure the Isopar® L limit will not be exceeded in Saltstone.
- Representative batch sampling and analysis at MCU shall occur to support the material balance and blend calculations.
- Transfers from Tank 50H to the Saltstone Facility shall be from a well-mixed Tank 50H to ensure the Isopar® L concentration is less than the limit.
- A material balance calculation shall be issued periodically to determine the Isopar® L concentration in Tank 50H. The Tank 50H Waste Compliance Plan (WCP) provides the methodology for performing material balance.

A Tank 50H blend calculation is performed to specify the allowable total volume of DSS that is permitted to be transferred from MCU to Tank 50H. This calculation includes a provision for an unanalyzed volume of DSS permitted in Tank 50H with a reasonably conservative assumed Isopar® L concentration. This calculation takes into account the
volume of transfers into and out of Tank 50H. Prior to transfer initiation from MCU to Tank 50H or transfer initiation out of Tank 50H, the transfer volume is verified to be within the bounds of the blend calculation. Transfers out of Tank 50H are monitored to ensure the volume transferred remains within the blend calculation. Prior to transfer, Tank 50H slurry pump(s) are operated to ensure adequate mixing of Isopar® L for transfers from Tank 50H to the Saltstone Facility. This ensures the blend calculation is representative of the Isopar® L concentration sent from Tank 50H (Ref. 30).

For SDUs, the contribution from volatiles in salt solution other than Isopar® L, benzene, hydrogen, and ammonia shall be evaluated using existing SDU flammability methodology. An engineering evaluation may be completed to demonstrate that the Composite Lower Flammability Limit (CLFL) of the SDU vapor space will not exceed 95% at the time the SDU is at the peak percent of CLFL.

If a new flammable species becomes evident in Tank 50H, it shall be evaluated to determine its contribution to flammability in the SSRTs, SFT, and SDUs prior to receiving additional transfers from Tank 50H. The analysis shall determine the percentage of the species LFL utilizing the measured concentration of the species in the vapor space. If the evaluation result is less than or equal to 0.5%, no further action is required. A threshold of 0.5% is appropriate as it has minimal impact to overall results of References 29, 44, 45, 46. Because of this minimal impact, allowance for cumulative additions of species less than or equal to 0.5% of the LFL is not required.

For SDUs, vapor space sampling historically demonstrates that there is only a marginal concentration of flammables in the vapor space. If the result is greater than 0.5%, SDUs 3 and 6 shall be evaluated per Reference 29 and 44 respectively to ensure the peak CLFL remains below 95% at the Maximum Grout Height (Ref. 29, 44). The evaluation may use actual parameters (e.g., pour schedule, pour flow rate, salt solution mass fraction, grout temperature) and constituent concentrations that has been sent to the SDU at the fill height at the time of discovery, but must use DSA inputs and assumptions from that height up to the Maximum Grout Height with the inclusion of the new species. SDUs 2, 4, and 5 have actual measurement data supporting their flammability basis, and will not be reevaluated because SDUs 2 and 5 are operationally filled and SDU 4 is inactive. The grout transfer line has been blanked to SDUs 2 and 5 and is no longer connected to SDU 4.

For SSRTs and SFT, margin is provided in the analysis as the SSRTs and SFT are assumed to be at an elevated temperature and in an overflow condition, minimizing the vapor space (Ref. 45, 46). However, if the result is greater than 0.5%, the SSRTs and SFT are not considered to be within the existing safety analysis.

The Saltstone Facility WAC Program shall ensure this remains valid by ensuring these volatiles are less than the analyzed values or by performing an analysis consistent with Reference 29 (for SDU 3) and Reference 44 (for SDU 6) to show the contribution remains within this limit. Calculations performed to ensure compliance with the WAC shall be performed consistent with Manual E7 which requires verification/checking.
4.5.2 SDU 3 CELL FILL HEIGHT (SAC 5.6.2.6)

4.5.2.1 Safety Function

The safety function of the SDU 3 Cell Fill Height SAC is to ensure that the minimum vapor space remains in SDU 3 Cells A and B to protect the analysis assumption that a CLFL condition cannot be created in the SDU vapor space when processing (during and following pouring) grout.

4.5.2.2 SAC Description

Controls shall be established to ensure SDU 3 cells are not filled above the specified level. The SDU 3 Maximum Grout Height provides a cell sufficient vapor space volume such that flammable vapor will not reach CLFL during and following the pouring of radioactive grout and/or clean cap grout.

The equipment required to support this SAC are the grout height indicators and proper valve alignment. In the event the SDU 3 Maximum Grout Height SAV is exceeded (which must be adjusted for grout height indicator uncertainty), the SDU Portable Ventilation System is available to minimize the potential for the cell to become flammable. The cells do not have automatic level indication and associated interlocks because of the slow fill rate and the required visual observations of the grout height indicators, which provide clear evidence of the grout height. There is sufficient time for operator action to shut down the process as required to prevent flammable conditions in the vapor space.

4.5.2.3 Functional Requirements

The grout level in SDU 3 cells shall remain less than or equal to the SDU 3 Maximum Grout Height SAV of 7.06.8 feet (which must be adjusted for grout height indicator uncertainty).

The grout height indicators, according to facility conditions, are required to perform the safety function of this SAC. Direct measurement of the grout height is indicative of the vapor space volume above the grout.

In the event the SDU 3 Maximum Grout Height SAV (which must be adjusted for grout height indicator uncertainty) is exceeded, the following equipment, according to facility conditions may be used to minimize the potential for the vapor space to become flammable:

- SDU Portable Ventilation System
- Portable Flammability Monitors

The grout level in SDU 3 cells shall remain less than or equal to the SDU 3 Maximum Grout Height SAV (which must be adjusted for grout height indicator uncertainty) and shall be ensured as follows:

Grout height and adequate available fill space shall be verified prior to initiating a pour into SDU 3 when above the cautionary grout height of 5.75 feet. Grout height shall be
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passive diurnal breathing) during and following the pouring of radioactive grout and/or clean cap grout. The SDU 3 Maximum Grout Height SAV is 7.0 feet as evaluated at the wall and includes mounding of the grout in the center of the cell as described in Reference 34. It does not account for the uncertainty associated with the readable accuracy of the grout height indicator(s) mounted on the cell columns (Ref. 45). Therefore, the SDU 3 Maximum Grout Height SAV shall be further adjusted to account for this uncertainty. The SDU Cell Grout Height Fill Limit for SDU 3 in the TSR includes uncertainty and is inclusive of any clean cap grout that may be required for ALARA considerations. The flammable constituents in the vapor space are a combination of organics, ammonia, and hydrogen. The SDU 3 Maximum Grout Height SAV ensures that the flammable constituents of the cell vapor space are below the CLFL.

The SDU 3 Maximum Grout Height SAV is derived from the SDU cell flammability analysis (Ref. 34).

- Grout height and adequate available fill space shall be verified prior to initiating a pour into an SDU 3 cell when grout height is above the cautionary grout height of 5.75 feet (height has been adjusted for uncertainty) (Ref. 45). SDU 2 uncertainty (Ref. 45) is applicable to SDU 3 cells because of similar construction and features. Grout height shall be determined within a timeframe based on engineering judgment that provides reasonable assurance that any changes in grout height can be detected and responded to prior to initiation of grout pouring. The verification of grout height shall be performed by visual observation only (CCTV may be used) prior to the pour. Grout height is determined by utilizing any one of the three grout height indicators. Grout height shall be determined periodically while pouring and following completion of the grout pour. These other verifications of cell fill height shall be verified to be within the limits by selecting any one of the three grout height indicators or by calculating the grout fill height using the known run time since the last visual observation of fill height and the bounding grout pump flow rate or the actual processing rates, if available. Flow rate instrumentation shall meet IPI or M&TE requirements (Section 5.5.2.8) if actual processing rates are used. The periodicity shall be sufficient to ensure that actions may be taken to minimize the potential for the vapor space to become flammable. The periodicity should consider the slow rate of fill of the SDU and recognize the delayed release of volatiles from the grout [peak CLFL is reached at approximately 180 days following the final pour (Ref. 34)].

- If grout height is indicated to be greater than the SDU 3 Maximum Grout Height SAV (which must be adjusted for grout height indicator uncertainty) on one of the grout height indicators during or following grout pouring, the facility is outside of compliance with this SAC.
  
  o Stop introduction of salt solution and dry premix feed to the SDU cell immediately. Immediately stopping addition of salt solution and dry premix feeds minimizes the reduction in vapor space volume and the introduction of additional flammable gas contributors. Shutdown logic immediately stops the dry premix feed, but allows the residual dry premix feed in the mixer inlet chute to be processed. Additional flushing with IW or PW continues after stopping salt solution and dry premix feed to the mixer. The addition of this flush water to the

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5.7 INTERFACE WITH TSRS FROM OTHER FACILITIES

The Saltstone Facility receives waste streams from CSTF Tank 50H. The inter-area transfer line is also shared with SWPF. In order to provide assurance that the Saltstone Facility inventory input and MAR assumptions remain valid and that waste received by the Saltstone Facility does not result in unacceptable exposure to offsite and onsite personnel, CSTF and SWPF shall comply with the following requirements.

5.7.1 SALTSTONE FACILITY WAC (SAC)

CSTF shall maintain a Waste Compliance Plan (WCP) to demonstrate compliance with the Saltstone Facility WAC Program. In addition, further additions of TPB to Tank 50H shall be prohibited.

The WCP will specify the actions and technical evaluations that ensure that the functional requirements of the Saltstone Facility WAC Program are met. The WAC specifies requirements for flammable constituent concentrations, HGR, and salt solution receipt temperature, among others (see Section 3.3.2.3). Tank 50H temperature instrumentation/monitoring and periodic sampling (accounting for analytical uncertainty as described in Section 5.5.2.1) of waste receipt tanks gives additional assurance that the safety function is met (Ref. 19).

5.7.2 INTERFACE WITH CONCENTRATION, STORAGE, AND TRANSFER FACILITIES CSTF CONTROLS ON TRANSFERS TO THE SALTSTONE FACILITY (SAC)

CSTF to SPF Transfer Requirements Imposed on CSTF

In addition to meeting the Saltstone Facility WAC Program requirements for the Saltstone Facility, the following CSTF TSR controls shall be implemented for transfers to the Saltstone Facility to preclude or mitigate potential accident scenarios for the Saltstone Facility. These requirements are not part of the SAC unless specifically noted.

- Monitoring and material balance requirements to detect transfer events shall be determined. The frequency and method (e.g., level/leak monitoring) of monitoring and material balances for a transfer and the required monitoring locations (including those past the first isolation point) shall be determined on an individual basis.
- Siphon evaluations shall be performed. This evaluation will identify the potential for siphons and identify methods and equipment needed to stop siphons.
- Prior to transfer initiation, independent verification of correct transfer path alignment shall be completed. After initiating the transfer, use of correct motive force shall be independently verified.
- Prior to transfer initiation, procedures shall identify (including staging requirements) the functional equipment needed to stop transfers and siphons. This requirement is a SAC. Stopping an unintended siphon shall be completed as soon as practical based on plant conditions through the use of appropriate transfer procedure (typically accomplished by closing appropriate waste transfer valves). Once the siphon has been stopped, the need for a rapid response is no longer required and breaking the siphon is not time dependent.
- Isolate the transfer route when transfers to the Saltstone Facility are terminated. This requirement is a SAC.
Material balance discrepancies shall be less than or equal to 15,000 gallons. If material balance discrepancies are greater than 15,000 gallons, then the affected transfers shall be terminated immediately. This requirement is a SAC.

Re-zeroing of material balances may be completed prior to reaching the applicable transfer procedure shutdown criteria and shall include a documented technical basis. The primary means of re-zeroing shall be accomplished by verifying no indications of a leak in the leak detection equipment. Video inspection of the interior of the sending and receipt tanks for the presence of salt mounds may be utilized and if salt mounds exist, the material balance may be re-zeroed.

Procedures shall specify communication protocol during transfers.

Ensure during a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, transfers are terminated and a siphon break established at Tank 50H. This requirement is a SAC.

The above SACs shall be identified in the CSTF DSA (Ref. 19). CSTF equipment relied upon to implement these SACs, dependent upon the particular control, is described in the CSTF DSA (Ref. 19).

The Saltstone Facility derivation of each SAC is described in the following sub-sections.

5.7.2.1 Equipment Needed to Stop Transfers and Siphons (SAC)

5.7.2.1.1 Safety Function

The safety function of this SAC is to ensure that CSTF procedures identify the functional equipment needed to stop transfers and siphons in order to protect hazard and accident analyses MAR assumptions related to the maximum volume of waste in the Saltstone Facility.

5.7.2.1.2 SAC Description

The Saltstone Facility SB assumes that a maximum volume of 15,000 gallons of salt solution is releasable from CSTF Tank 50H to SPF transfer events and 43,600 gallons of DSS from SWPF to Tank 50H transfer events, which are a conservative amount. Procedures identified by CSTF that control the transfer operations that affect the Saltstone Facility must identify the functional equipment needed to stop transfers and siphons in order to protect hazard and accident analyses volume of waste assumptions.

Tank 50H to SPF Salt solution transfers are controlled in the CSTF. The Saltstone Facility receives the waste transfer, while the CSTF leads the procedural activities to conduct the transfer. Since a siphon from Tank 50H to the Saltstone Facility cannot always be stopped from the Saltstone Facility, CSTF procedures shall identify the functional equipment needed to ensure that transfers and siphons can be stopped so that assumed salt solution volumes at the Saltstone Facility are not exceeded. These procedural controls for the transfer ensure that transfers and siphons can be stopped protecting the Saltstone Facility hazard and accident analyses assumptions.
INSERT B:

**SWPF to CSTF Transfer Requirements Imposed on CSTF**

The SWPF and CSTF share a common inter-area transfer line with the Saltstone Facility. The Saltstone Facility inter-area transfer piping and associated isolation valves are located below the elevation of both Tank 50H and the SWPF DSSHT.

In addition to meeting the Saltstone Facility WAC Program requirements for the Saltstone Facility, the following CSTF TSR controls shall be implemented for transfers from SWPF to Tank 50H to preclude or mitigate potential accident scenarios in the Saltstone Facility. These requirements are not part of the SAC unless specifically noted.

- Siphon evaluations shall be performed. This evaluation will identify the potential for siphons and identify methods and equipment needed to stop siphons.
- Prior to transfer initiation, procedures shall identify (including staging requirements) the functional equipment needed to stop siphons to the Saltstone Facility following termination of an SWPF to Tank 50H transfer (when aligning a Tank 50H to SPF transfer, transfer line draining into the SPF is due to the difference in elevation and is not an indication of a siphon event, a siphon is prevented due to the siphon break at Tank 50H). This requirement is a SAC.
  
  Stopping an unintended siphon shall be completed as soon as practical based on plant conditions through the use of appropriate transfer procedure (typically accomplished by closing appropriate waste transfer valves). Once the siphon has been stopped, the need for a rapid response is no longer required and breaking the siphon is not time dependent.
- Procedures shall specify communication protocol during transfers.
- Ensure during a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, transfers are terminated and a siphon break established at Tank 50H. This requirement is a SAC.

INSERT C:

**SWPF to Tank 50H transfers are controlled in the SWPF. Since a siphon from Tank 50H to the Saltstone Facility cannot always be stopped from the Saltstone Facility, CSTF procedures shall identify the functional equipment needed to ensure that siphons can be stopped so that the assumed salt solution volumes (15,000 gallons - CSTF initiated transfers / 43,600 gallons - SWPF initiated transfers) at the Saltstone Facility are not exceeded. These procedural controls for the transfer ensure that siphons can be stopped, protecting the Saltstone Facility hazard and accident analyses assumptions.**
5.7.2.1.3 Functional Requirements

Prior to transfer initiation from Tank 50H to the Saltstone Facility, procedures shall identify the functional equipment needed to stop transfers and siphons.

Prior to transfer initiation from SWPF to Tank 50H, procedures shall identify the functional equipment needed to stop siphons.

5.7.2.1.4 SAC Evaluation

To protect the hazard and accident analyses assumption related to the total volume of salt solution in the Saltstone Facility from CSTF transfer events and DSS from SWPF transfer events, a SAC shall be developed by CSTF Operations and enforced within the CSTF DSA/TSR to ensure that procedures identify the functional equipment needed to stop transfers to the Saltstone Facility and siphons after a Tank 50H to SPF transfer or an SWPF to Tank 50H transfer. CSTF procedures that identify the functional equipment needed to ensure that transfers and siphons can be stopped so that assumed salt solution volumes at the Saltstone Facility are not exceeded protects hazard and accident analyses assumptions. CSTF equipment used to stop transfers and siphons and its reliability to the Saltstone Facility is evaluated in Reference 19.

5.7.2.2 Transfer Route Isolation (SAC)

5.7.2.2.1 Safety Function

The safety function of this SAC is to ensure that the transfer route is isolated when transfers to the Saltstone Facility are terminated to protect hazard and accident analyses MAR assumptions related to the maximum volume of waste in the Saltstone Facility.

5.7.2.2.2 SAC Description

Waste in the form of salt solution is only transferred to the Saltstone Facility from Tank 50H using an inter-area transfer route. Transfers from Tank 50H are directed to the Saltstone Facility via a pre-identified transfer route which uses inter-area piping and a valve box located between Tank 50H and the Saltstone Facility. Salt solution transfer equipment located in the CSTF required to isolate the transfer route to the Saltstone Facility shall be verified closed in order to ensure the prevention of unintended transfers to the Saltstone Facility. Transfers within other CSTF areas also use specified transfer routes that when in use, may be common to the same transfer route piping located within the same valve box as used for transfers to the Saltstone Facility. The isolation of the transfer route to the Saltstone Facility is required to protect hazard and accident analyses assumptions related to the Saltstone Facility.

5.7.2.2.3 Functional Requirement

Isolate the transfer route when transfers to Saltstone Facility are terminated.

5.7.2.2.4 SAC Evaluation

To protect the hazard and accident analyses assumption related to the total volume of salt solution in the Saltstone Facility from CSTF transfer events, a SAC shall be developed by CSTF Operations and enforced in the CSTF DSA/TSR to ensure that the isolation of the transfer route to the Saltstone Facility is maintained when not in use in order to ensure the prevention of unintended transfers to the Saltstone Facility. An independent verification process to ensure
isolation of the transfer line is required. CSTF procedures that identify the equipment required to be isolated upon transfer termination with an independent verification function ensures that the transfer line to the Saltstone Facility is appropriately isolated. These actions by CSTF are considered reliable because they are routine tasks using approved procedures as described in Reference 19. Independent verification is considered adequate to ensure that the transfer line is isolated to the Saltstone Facility.

5.7.2.3 Material Balance Discrepancies (SAC)

5.7.2.3.1 Safety Function

The safety function of this SAC is to ensure that transfers to the Saltstone Facility are terminated before exceeding the material balance discrepancy limit of 15,000 gallons. Terminating the transfer ensures that the hazard and accident analyses assumptions related to the maximum volume of transferred and/or missing waste is less than or equal to 15,000 gallons.

5.7.2.3.2 SAC Description

Material balance discrepancies related to transfers to the Saltstone Facility shall be less than or equal to 15,000 gallons. If material balance discrepancies are greater than 15,000 gallons, then the affected transfers shall be terminated immediately. A total volume of 15,000 gallons of salt solution is assumed from the CSTF transfer events as the bounding volume of waste analyzed in the development of the hazard and accident analyses related to the Saltstone Facility SB. The Saltstone Facility inter-area transfer line flow indications and the SSRT/SFT level indicators are used to perform the material balance determination for waste transfers from CSTF.

5.7.2.3.3 Functional Requirement

Material balance discrepancies shall be less than or equal to 15,000 gallons. If material balance discrepancies are greater than 15,000 gallons, then the affected transfers shall be terminated immediately.

5.7.2.3.4 SAC Evaluation

To protect the hazard and accident analyses assumption related to the total volume of salt solution in the Saltstone Facility from CSTF transfers, a SAC shall be developed by CSTF Operations and enforced in the CSTF DSA/TSR to ensure that material balance discrepancies related to transfers to the Saltstone Facility shall be less than or equal to 15,000 gallons and if material balance discrepancies are greater than 15,000 gallons, then the affected transfer shall be terminated immediately. The actions required by this SAC are considered to be routine tasks governed by approved procedures. The Saltstone Facility inter-area transfer line flow indicators and the SSRT/SFT level indicators are required to support this SAC during Tank 50H to SPF transfers. In the event the in-line flow meter monitoring the incoming Tank 50H to SPF transfer becomes non-functional, material balance calculations for the salt solution received can be performed using an approved Saltstone Facility procedure to allow for continuation of salt solution transfers. Functionality of this equipment is supported by the NMMP in accordance with Manual 1Y as described in Chapter 10. CSTF equipment relied upon to implement this SAC is described in the CSTF DSA (Ref. 19).
The following assures functionality of equipment used for this SAC:

- Saltstone Facility inter-area transfer line flow indicators – IPI (Section 5.5.2.8)
- SSRT/SFT level indicators – IPI (Section 5.5.2.8)

5.7.2.4  Transfer Termination and Isolation During/Following NPH Events (SAC)

5.7.2.4.1  Safety Function

The safety function of this SAC is to ensure that, during a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, CSTF procedures provide for termination of the **Tank 50H to SPF** transfer, and establishing a siphon break at **Tank 50H**, in order to protect hazard and accident analyses MAR assumptions related to the maximum volume of waste in the Saltstone Facility. **Additionally, following termination of an SWPF to Tank 50H transfer, CSTF procedures provide for establishing a siphon break at Tank 50H. Establishing the siphon break prevents a siphon from Tank 50H to the SPF.**

5.7.2.4.2  SAC Description

The Saltstone Facility SB assumes that a maximum volume of 15,000 gallons of salt solution is releasable from CSTF to SPF transfer events and 43,600 gallons DSS from SWPF to CSTF transfer events, which are a conservative amount. Procedures identified by CSTF that control the transfer operation to the Saltstone Facility during NPH events must stop transfers and siphons. **Procedures identified by CSTF that secure transfers from SWPF during NPH events must stop siphons. These actions in order to protect hazard and accident analyses volume of waste assumptions.**

**Tank 50H to SPF** Salt solution transfers are controlled in the CSTF. The Saltstone Facility receives the waste transfer, while the CSTF leads the procedural activities to conduct the transfer. These pProcedural controls for the transfer ensure that transfers are terminated and a siphon break is established to protect the Saltstone Facility hazard and accident analyses assumptions.

5.7.2.4.3  Functional Requirements

During a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, transfers are terminated and a siphon break established at **Tank 50H**.

5.7.2.4.4  SAC Evaluation

To protect the hazard and accident analyses assumption related to the total volume of salt solution in the Saltstone Facility from CSTF to SPF transfer events and DSS from SWPF to **Tank 50H transfer events**, a SAC shall be developed by CSTF Operations and enforced within the CSTF DSA/TSR to ensure that procedures prescribe the methods necessary to ensure **Tank 50H to SPF** transfers are terminated and a siphon break is established at **Tank 50H** and a siphon break is established at **Tank 50H following termination of SWPF to Tank 50H transfers** during or following NPH events. CSTF equipment used to stop transfers and siphons and its reliability to the Saltstone Facility is evaluated in Reference 19. Second person verification shall be performed for transfer termination and establishment of the siphon break. This verification is considered adequate to ensure the transfer/siphon is terminated.

The above indicated controls were designated as SACs in order to protect bounding initial conditions, which cannot be performed by an SSC.
INSERT D:

The SWPF to Tank 50H transfers are controlled from the SWPF. Following termination of the transfer, a siphon break is established at Tank 50H to protect the Saltstone Facility hazard and accident analyses assumptions.
Adequate conservatism exists for controls within these SACs based on the use of 15,000 gallons for maximum MAR for Saltstone Facility transfer events initiated from the CSTF, 43,600 gallons for maximum MAR for Saltstone Facility transfer events initiated from the SWPF, and the physical configuration of the Saltstone Facility. These MAR values are fifteen thousand gallons is the maximum MAR for salt solution transfer events (associated with the CSTF) evaluated in the Saltstone Facility CHA and is the inventory assumed for these events in the Hazard Categorization determination for the Saltstone Facility. Additional conservatism exists through understanding that the curie content and chemical concentrations of the waste in a Tank 50H to SPF transfer or an SWPF to Tank 50H transfer sent to the Saltstone Facility from the CSTF are normally well below the values that have been analyzed for Saltstone Facility events.

5.7.3 INTERFACE WITH SALT WASTE PROCESSING FACILITY (SAC)

SWPF to CSTF Transfer Requirements Imposed on SWPF

The SWPF to CSTF transfer shares a common inter-area transfer line with the Saltstone Facility. The Saltstone Facility inter-area transfer piping and associated isolation valves are located below the elevation of both Tank 50H and the SWPF DSSHT. The following SWPF TSR control shall be implemented for transfers to the CSTF that will preclude potential accident scenarios for the Saltstone Facility.

- Ensure during a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, SWPF to Tank 50H transfers are terminated. This requirement is a SAC.

The above SAC shall be identified in the SWPF DSA (Ref. AA). SWPF equipment relied upon to implement this SAC, dependent upon the particular control, is described in the SWPF DSA (Ref. AA).

The Saltstone Facility derivation of this SAC is described in the following sub-section.

5.7.3.1 Transfer Termination and Isolation During/Following NPH Events (SAC)

5.7.3.1.1 Safety Function

The safety function of this SAC is to ensure that, during a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, SWPF procedures provide for termination of the transfer, in order to protect hazard and accident analyses MAR assumptions related to the 43,600-gallon volume of DSS in the Saltstone Facility.
5.7.3.1.2 SAC Description

The Saltstone Facility SB assumes that a maximum volume of 43,600 gallons of DSS is releasable from SWPF during and following an NPH event, which is a conservative amount. Procedures identified by SWPF that control the transfer operation to the CSTF during NPH events must stop transfers to Tank 50H in order to protect hazard and accident analyses volume of the Saltstone Facility waste assumptions.

Transfers to Tank 50H are controlled by the SWPF. Procedural controls for the transfer ensure that transfers are terminated to protect the Saltstone Facility hazard and accident analyses assumptions.

5.7.3.1.3 Functional Requirements

During a tornado watch/tornado warning/high wind warning, following a Tornado/High Wind Event, or following an earthquake, SWPF to Tank 50H transfers are terminated.

5.7.3.1.4 SAC Evaluation

To protect the hazard and accident analyses assumption related to the total volume of salt solution in the Saltstone Facility from SWPF to Tank 50H transfer events, a SAC shall be developed by SWPF Operations and enforced within the SWPF DSA/TSR to ensure that procedures prescribe the methods necessary to ensure transfers are terminated during or following NPH events. SWPF equipment used to stop transfers and its reliability to the Saltstone Facility is evaluated in Reference AA. Independent verification shall be performed for transfer termination. This verification is considered adequate to ensure the transfer is terminated.

The above indicated control is designated as a SAC in order to protect bounding initial conditions, which cannot be performed by an SSC.

Adequate conservatism exists for controls within this SAC based on the use of 43,600 gallons for maximum MAR for Saltstone Facility events initiated from an SWPF to Tank 50H transfer considering the physical configuration of the Saltstone Facility. 43,600 gallons is the maximum MAR for SWPF to Tank 50H transfer events (volume associated with the SWPF DSSHT) evaluated in the Saltstone Facility CHA and is the inventory assumed for these events in the Hazard Categorization determination for the Saltstone Facility. Additional conservatism exists through understanding that the curie content and chemical concentrations in the waste in the SWPF to Tank 50H transfer are normally well below the values that have been analyzed for Saltstone Facility events.
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inhertently present in the sludge keep the sludge subcritical under all normal and credible abnormal conditions.

6.3.2 FISSILE MATERIAL PRECIPITATION IN SSRT OR SFT

Potential mechanisms for precipitation of fissile materials from the salt solution in the SSRTs or SFT were evaluated in this scenario. The precipitation mechanisms that were evaluated were temperature changes, dilution of salt solution, pH changes, and the grout component’s affinity for fissile material. Considering: 1) the lack of a mechanism to appreciably precipitate fissile material, 2) the low solubility of fissile materials in salt solutions and corresponding limited mass of fissile material in an SSRT or the SFT, and 3) the large SSRT cross sectional area, criticality in an SSRT or the SFT, due to precipitation, is judged incredible.

6.3.3 FISSILE MATERIAL CONCENTRATION IN SSRT OR SFT DUE TO EVAPORATION

The SSRTs and SFT are vented to the SSRT PVVS and Facility PVVS respectively, which can potentially cause excessive evaporation of the waste salt solution, resulting in increased concentration of fissile material in the SSRTs or SFT. Considering, 1) the low solubility of fissile materials in salt solutions that is the basis for criticality safety of such solutions, 2) the neutron absorbing elements associated with the insoluble fissile solids in sludge, and 3) the large tank SSRT cross sectional area (nominally 26 feet in diameter for SSRT and 12 feet in diameter for SFT), criticality in an SSRT or the SFT, due to excessive evaporation is judged incredible.

6.3.4 LONG TERM FISSILE MATERIAL ACCUMULATION IN SSRT OR SFT

This scenario postulates long-term accumulation of fissile material in an SSRT or the SFT due to receiving and processing a large volume of salt solution. Long-term accumulation of fissile solids at the bottom of an SSRT or the SFT is not a criticality concern because of the low concentration of fissile solids in the salt solutions and presence of neutron absorbing elements such as iron and manganese in the small amount of sludge entrained in salt solution. There are no mechanisms in an SSRT or the SFT for preferential accumulation of fissile material. Therefore, this is not a credible criticality concern.

6.3.5 COLLECTION OF FISSILE MATERIAL IN SSRT OR SFT DUE TO INTENDED TRANSFERS FROM TANK 50H

Intended transfers of waste salt solution from Tank 50H to an SSRT or the SFT require characterization of the salt solution and demonstrated compliance with the Saltstone Facility WAC program prior to transfer to Z-Area to ensure that the concentrations of the fissile isotopes in the salt solution are within the WAC limits. The WAC concentration limits maintain the concentration of fissile materials well below the single parameter subcritical concentration limit for U-235. Tank 50H solids potentially sent to an SSRT or the SFT do not have an affinity for uranium and have no appreciable affinity for neptunium or plutonium that would lead to a critical configuration in the Tank 50H solids. Additionally, there are no physical or chemical mechanisms that can change properties of material transferred to an SSRT or the SFT.
as a result of dilution of the transferred salt solution would be insignificant to cause a criticality concern due to the large PW Tank inner cross sectional area (~21 feet in diameter). Therefore, a criticality in the PW Tank, due to an inadvertent transfer of salt solution from an SSRT or the SFT, or due to small leaks through the isolation valves, is incredible.

6.3.10 FISSILE MATERIAL ACCUMULATION IN SALTSTONE HOPPER OVERFLOW CONTAINER

Because of the very low concentration of fissile materials in the salt solution and the small volume of the SHOC, accumulation of enough fissile materials in the SHOC to exceed the subcritical aqueous solution fissile mass limit is not a credible criticality concern.

6.3.11 FISSILE MATERIAL CONCENTRATION IN SSRT OR SFT DUE TO THE PRESENCE OF THE SOLVENT USED IN THE SWPF/MCU PROCESS

This scenario postulates concentrating fissile material in an SSRT or the SFT due to the presence of the Caustic Side Solvent Extraction (CSSX) solvent used in the SWPF/MCU process. Studies have shown that the CSSX solvent in alkaline solution does not appreciably extract uranium and plutonium from the alkaline salt solution. Concentrations of uranium and plutonium in the solvent in contact with alkaline salt solution are no greater than the concentrations in the alkaline salt solution (which in Tank 50H, an SSRT, or the SFT are much less than subcritical concentration limits). Therefore, criticality in an SSRT or the SFT, due to the concentration/accumulation of fissile material in the CSSX solvent, is incredible.

6.3.12 FISSILE MATERIAL PRECIPITATION IN SSRT OR SFT DUE TO INADVERTENT TRANSFER OF SCRUB OR STRIP SOLUTION FROM SWPF/MCU

This scenario postulates precipitation of fissile material in an SSRT or the SFT due to chemistry changes as a result of receiving an inadvertent nitric acid (Scrub Feed or Strip Feed from BOBCalix-based solvent) or boric acid (from NGS Strip Feed) transfer from either SWPF or MCU via Tank 50H. An inadvertent transfer of either acid to the Decontaminated Salt Solution Hold Tank (DSSHT) is extremely unlikely due to SWPF/MCU facility configuration since there is no direct line between the acid tanks and the DSSHT. However, if a transfer were to occur, a criticality accident in the DSSHT due to the addition of acid is deemed incredible due to minimal fissile material precipitation from acid addition. Since any transfers from the DSSHT to Tank 50H (and then to an SSRT or the SFT) of DSS exposed to a significant amount of acid will result in further dilution of the acid both in Tank 50H and in an SSRT or the SFT, the effect of the acid in an SSRT or the SFT will be much less than in the DSSHT. Boric acid is a weaker acid than nitric acid and its effects on precipitation in the DSS will be bounded by the nitric acid effects. The effect of NaOH as the scrub is also bounded by the effect of nitric acid. Therefore, criticality in an SSRT or the SFT due to the addition of scrub or strip solution to either the DSSHT with subsequent transfer to an SSRT or the SFT is incredible.

6.3.13 FISSILE MATERIAL PRECIPITATION/ACCUMULATION IN SSRT OR SFT AND GROUT MIXER DUE TO Q2 (ACP) AND DARATARD 17 ADDITIONS

This scenario postulates potential precipitation/accumulation of fissile material in an SSRT or the SFT and grout mixer due to the addition of dilute Q2 (ACP) and Daratard 17. Although the
6.3.17 GROUT HYDRATION REACTIONS

In an SDU, hydration reactions convert the grout to a stable solid that immobilizes all fissile materials in the solidified grout. From hydration of the grout, the concentration of fissile materials in the grout does not increase significantly by a factor of 1.22 (Ref. 2). This fissile material concentration change remains well below the single parameter subcritical concentration limit for U-235. Therefore, this scenario does not pose a credible criticality concern.

6.3.18 ACCUMULATION OF FISSILE MATERIAL IN THE CCBT OR SFT ENCLOSURES DUE TO A LEAK

The CCBT does not usually contain fissile material. The SFT may contain fissile material from Tank 50H. The salt solution transfer line goes through both the CCBT and SFT enclosures. Therefore, it is possible to have a leak into the CCBT or SFT enclosures that would contain fissile material. Both the CCBT and SFT enclosures contain a 3 ft x 3 ft sump. A large leak would evaporate on the floor. It is not credible to exceed the areal density on the floor (see Section 6.3.14). Assuming a 10 gal/day leak, it would take 3.5 years to accumulate sufficient fissile material to exceed the areal density within either sump. Therefore, a criticality due to accumulation of fissile material from leaks into the CCBT or SFT enclosures is not credible.

6.3.19 ACCUMULATION OF FISSILE MATERIAL IN THE 210-Z PROCESS ROOM DUE TO A LEAK

Salt solution can leak into the process room. The process room does not contain a sump. Instead, it has a trench which drains to the SFT. The spill could contain 4,200 grams of U-235 (eq), assuming the solution is at the DSA limit. Based on the size of the trench, over 12,000 grams would have to accumulate to exceed the areal density within the trench. Small leaks are not a concern for the process room as there is no collection point. If the drain to the SFT was plugged, the small leaks would not have a collection point and would be similar to a large leak and spread over the trench. Therefore, a criticality due to accumulation of leaks in the process room is not credible.

6.3.20 FREEZING OF MATERIAL IN SSRT OR SFT

This scenario postulates a criticality in an SSRT or the SFT due to the tank contents freezing and concentrating the fissile material. Due to the low initial fissile material concentration, it is not credible freezing could concentrate the fissile material by a factor of 150, which is required to exceed the subcritical concentration limit.

In summary, the NCSE identified no credible criticality scenarios for the SPF or SDF. The NCSE is valid for fissile material concentrations in salt solutions that result in fissile activity limits less than or equal to the DSA bounding concentrations (refer to Chapter 3, Table 3.6-6).
6.3.21 INADVERTENT TRANSFER FROM SWPF

The SWPF transfers DSS to Tank 50H for disposal in Saltstone. However, unlike MCU, the SWPF DSS transfer line to Tank 50H is shared with the Tank 50H salt solution transfer line to Saltstone. Therefore, it is possible for SWPF to inadvertently transfer directly to Saltstone. The SWPF DSSHT is the sending tank for SWPF transfers and has a capacity of 43,600 gallons. The inadvertent transfer of SWPF material meant for Tank 50H being sent to Saltstone does not create a criticality concern. During normal operations, the DSS from SWPF will have a lower concentration than the incoming feed to SWPF as the salt solution will have been struck with MST to remove fissile material. The incoming feed to SWPF has a fissile concentration below the Saltstone WAC limit. Therefore, an inadvertent transfer would still be within the values analyzed by the NCSE (Ref. 2). A large inadvertent transfer may overflow the SSRT, but this would be similar to a large leak (see Section 6.3.14). Inadvertently transferring the entire tank from SWPF would bound any residual material in the transfer line. Therefore, a criticality due to an inadvertent transfer from SWPF is not credible.
performed upon SRSOC notification of a tornado warning or high wind warning. The system is designed such that operator actions can be taken to secure transfers from the SSRTs and SFT (or isolate the SSRTs and SFT discharge paths) if required.

During periods when the Saltstone Facility is not operating, one operator performs daily rounds on SSRT equipment/alarm status to ensure SSRT agitator(s) operation is secured. This may be accomplished by a Saltstone Facility operator when staffed or a DWPF operator qualified to ensure SSRT agitator(s) operation is secured.

Operator interface with the grout height indicators was designed to minimize operator errors and improve operator efficiency. The grout height indicators identify the SDU and are numbered in whole feet with additional markings every ¼ foot for SDU 2, 3, 5, and 6. Operator actions to shut down grout production operations upon exceeding the Maximum Grout Height do not require additional training, as shutdown is a routine operation. Shut down of grout production operations includes monitoring and control of DCS indications and interface, displays, alarm systems, user-system interaction, trending and historical data collection, and other general and operation and control functions.

Operator interface with the SSRT agitator(s) and SSRT and SFT transfer operations was designed to minimize operator errors and improve operator efficiency. Operator actions to secure the SSRT agitator(s) and transfers from the SSRTs and SFT do not require additional training, as securing the SSRT agitator(s) and transfers from the SSRTs and SFT are routine operations. Securing SSRT agitator(s) and SSRT and SFT transfer operations includes monitoring and control of DCS indications and interface, displays, alarm systems, user-system interaction, trending and historical data collection, and other general operation and control functions.

The stopping of the introduction of salt solution and dry premix feeds to the SDUs are normal operations for the facility for which operating procedures exist.

The securing of the SSRT agitator(s) and the transfers from the SSRTs and SFT are normal operations for the facility for which operating procedures exist.

The remaining credited actions related to these SSCs are required to be performed over a longer time period (i.e., required to be performed in hours, not minutes). These actions were qualitatively assessed for human performance issues as part of the control selection process, and TSR development. The operator actions are defined in the TSRs. Operations personnel are trained and drilled on the TSR and response to the TSR abnormal conditions.

13.5.2 SCENARIO DEFINING OPERATOR ACTION

Chapter 3 identifies operator actions which are required to protect the assumptions of the hazards analysis. The hazards analysis assumes the maximum potential missing waste from a Tank 50H to SPF transfer and an intra-area spill event will be limited to 15,000 gallons. This was qualitatively determined to be bounding for spills in the Saltstone Facility based on the evaluation previously performed for the Concentration, Storage and Transfer Facilities (CSTF) (Ref. 13). The CSTF DSA assumes an unmitigated maximum missing waste of 15,000 gallons based on leak detection time, leak mitigation time,
17.0 MANAGEMENT, ORGANIZATION, AND INSTITUTIONAL SAFETY PROVISIONS

17.1 INTRODUCTION

This chapter of the Saltstone Facility DSA discusses general aspects of the following:

- The overall structure of the organizations and entities involved in safety-related functions not described elsewhere in this DSA, including key responsibilities and interfaces
- The safety programs that promote safety consciousness and morale, including safety review and performance assessment, configuration and document control, occurrence reporting, and safety culture

This chapter relies heavily upon the information provided in the Management Requirements and Procedure Manual 1B (Ref. 2) and refers to it as necessary. The management, organization, and institutional safety provisions as described in Procedure Manual 1B have been developed and implemented through site wide programs.

17.2 REQUIREMENTS

The S/RIDs (Ref. 3) state the codes, standards, and regulations governing the management, organization, and institutional safety provision elements of the SRS. Programmatic compliance assessments are performed against the S/RIDs and documented as specified in the Compliance Assurance Manual 8B (Ref. 4). The Standards Management/Compliance Section maintains records of the programmatic compliance assessments.

The format and content of this chapter satisfies the requirements of DOE-STD-3009-94 (Ref. 1).

17.3 ORGANIZATIONAL STRUCTURE, RESPONSIBILITIES, AND INTERFACES

17.3.1 ORGANIZATION STRUCTURE

Savannah River Remediation LLC (SRR) is the current Liquid Waste Contractor as of July 01, 2009. SRS management and operations are currently the responsibility of the Management and Operations (M&O) contractor, and the LW contractor, and the SWPF contractor. LW is the parent organization of the Saltstone Facility. The LW organization is managed by its President and Project Manager. LW includes the following project organizations:

- Engineering
- Closure Projects (part of CSTF)
- Environmental, Safety, Health, and Quality Assurance (ESH&QA)
- Projects, Design and Construction
SAFETY BASIS DOCUMENT CHANGE REQUEST (CRF) FORM

This form supports S4, ENG.02, Safety Basis Document Revision and Implementation Process.

1. SBD Change Request Form No.: SBD-CRF-Z-19002  Revision No.: 0  
   Manual: WSRC-IM-2004-00028  Date: Jan 2019

2. SBD No.: WSRC-SA-2003-00001  Title: Saltstone Facility Documented Safety Analysis  
   Rev/Date: 15 / July 2018

NOTE: When using a CRF to initiate and track a OSR/TSR revision, mark Blocks 5, 6, and 9 as N/A.

3. Affected Text Sections, Tables, and/or Figures:  
   2.10, 3.4.1.2, 3.5, 4.6, 13.6

4. Description of SBD Change:  
   Revise Saltstone Facility Safety Basis (DSA) to allow for the screening of chemicals.

5. Reason for SBD Change:  
   □ Annual Update  □ DOE Revision Issue  
   □ Plant Modification/Design Change  □ Change to Procedure as described in SBD  
   □ New/Revised Technical Information  □ Typographical Error  
   □ Safety Evaluation in support of TSR/OSR  □ Other (Attach Technical Justification)

6. References (Example - DCP, PCR, Technical Justification):  
   DOE-STD-1189-2008, SCD-11

7. Originating Approval:  
   Originator: G. E. Dorfler  Signature:  Date: 06 mar 2019  
   Safety Doc. Mgr: C. D. Cope  Signature:  Date: 03.04.19

8. Review and Issue/Comment Resolution Compleitions: (Mark as N/R if the review was not required.)  
   Design Authority Review: W. A. Condon  Completion Date: 3/6/2019  
   Interdisciplinary Review: N/R  Completion Date:  
   Consistency Review: D. W. Tepenny  Completion Date: 06 March 2019

9. Technical Review and USQ Screening:  
   Technical Review/USQ No.: TRP-SS-2019-00056  Date: 3/6/2019

10. CRP / Revision Approvals: (Must be signed before further approvals)  
    Safety Doc. Mgr: J. M. Bricker  Signature:  Date: 3/6/19  
    Mgr. Design Authority: E. J. Freed  Signature:  Date: 3/6/19

11. FOSC Review/Approval:  
    FOSC Chairman: J. E. Cantrell  Signature:  Date: 3/7/19  
    Implementation Checklist Required? □ Yes  □ No

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Page 53 of 60

29. **Saltstone Processing Facility Salt Solution Receipt Tank System Piping & Instrumentation Diagram.** M-M6-Z-00109, Rev. 7.


31. **Saltstone Facility Consolidated Hazard Analysis (U).** WSRC-TR-2001-00574, Rev. 19/18.
95th percentile results based on a statistical treatment of site meteorological data, and utilizes a surface roughness of 160 cm (Ref. 150). The offsite $\chi/Q$ is obtained from the MACCS/MACCS2 computer code.

TEDs are calculated in units of rem per gallon of salt solution. As mentioned previously, the radiological ST is calculated in units of gallons of salt solution; therefore, consequences in units of rem are obtained by a simple multiplication of the TED and the ST.

**Chemical Source Term Calculation**

The downwind consequences for chemicals are calculated according to the following:

$$C_i = \left(\frac{ST_m}{t}\right) \times \left(\frac{\chi}{Q}\right)$$

where $C_i$ is the airborne concentration of a particular chemical at receptor; $ST_m$, the mass-based source term for a particular chemical; $t$, the release duration; and $\chi/Q$, the atmospheric dispersion coefficient for the particular receptor of interest.

A 15 minute release duration is assumed because the applicable chemical guidelines are based on a 15 minute peak average value except for concentration dependent chemicals in an explosion, which use a 3 minute release duration.

The calculation results in the airborne concentration of the chemicals at the particular receptor. The concentration of chemicals is typically defined as a minimum ST for spills and explosions or MAR for fire scenarios, and are used as appropriate for comparison to EGs as discussed in the next section. For heating and boiling events, MAR is utilized due to the nature of the accident analysis methodology.

DOE-STD-1189-2008 (Ref. 132) states that concurrent releases of chemicals with a plausible release scenario should be assessed. SCD-11, Consolidated Hazard Analysis Process (CHAP) Program and Methods Manual (Ref. 37) allows screening of chemicals for mixtures, solutions, or solids as powders. This may be applied as appropriate. Screened chemicals and the specific screening methodology are annotated in individual CHAs. The screening process is established to select only those chemicals of concern for evaluation (i.e., type and quantity that have the potential for significant health effect on the FW, CW, or public). Following screening (if performed), this is done by first looking at the Sum of Fractions (SOF) is utilized to see if all of the chemicals of concern released at the same time will exceed PAC. The SOF involves summing all of the percentages of PAC together. If this percentage is less than 100%, then the release of all of the chemicals of concern does not exceed PAC. If the SOF exceeds 100%, the Mixture Methodology “Hazard Index” Excel File described in Reference 132 can be utilized to determine if the chemical release based on target organs would still exceed PAC values. If the SOF for any one target organ exceeds 100%, then the release would exceed PAC. Additionally, if the target organ values exceed PAC, the limiting ion process can be utilized. The limiting ion process, which is a refinement to the Chemical Mixture Methodology (CMM) process, evaluates chemicals containing common ions until the available mass of the limiting ion is exhausted or the resulting SOF for the target organ of concern is less than PAC. Solid or liquid materials that because of their physical form or other factors (e.g., plausible dispersal mechanisms), may not necessarily present an airborne exposure hazard (Ref. 37).

### 3.4.1.3 Comparison to Guidelines

The offsite and onsite (100 m) radiological exposure guidelines are 25 rem and 100 rem, respectively. These guidelines are taken from Reference 41. Consequences calculated to
3.5 REFERENCES


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4.6 REFERENCES


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13.6 REFERENCES

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11. Deleted
18. Deleted
19. Consolidated Hazard Analysis for Saltstone Disposal Units 3 and 5 Project. S-CHA-Z-00004, Rev. 3.
SAFETY BASIS DOCUMENT CHANGE REQUEST (CRF) FORM

This form supports S4, ENG.02, Safety Basis Document Revision and Implementation Process.

1. SBD Change Request Form No.: SBD-CRF-Z-19003 Revision No.: 0
   Manual: WSRC-IM-2004-00028 Date: March 2019

2. SBD No.: WSRC-SA-2003-00001 Title: Saltstone Facility Documented Safety Analysis
   Rev/Date: 15 / July 2018

NOTE: When using a CRF to initiate and track a OSR/TSR revision, mark Blocks 5, 6, and 9 as N/A.

3. Affected Text Sections, Tables, and/or Figures:
   2.5.2.3

4. Description of SBD Change:
   Revise Saltstone Facility Safety Basis (DSA) to reflect installation of equipment in the Grout Pump vent lines to the Saltstone Hopper Overflow Container (SHOC).

5. Reason for SBD Change:
   □ Annual Update  □ DOE Revision Issue
   ☑ Plant Modification/Design Change  □ Change to Procedure as described in SBD
   □ New/Revised Technical Information  □ Typographical Error
   □ Safety Evaluation in support of TSR/OSR  □ Other (Attach Technical Justification)

6. References (Example - DCP, PCR, Technical Justification):
   J-DCP-Z-18002 Rev. 0

7. Originating Approval:
   Originator: A. W. Jung Signature: Date: 10 June 2019
   Safety Doc. Mgr: C. D. Cope Signature: Date: 06.10.19

8. Review and Issue/Comment Resolution Completions: (Mark as N/R if the review was not required.)
   Design Authority Review: S. C. Shah Completion Date: 6-11-2019
   Interdisciplinary Review: M. J. Hart Completion Date: 6-10-19
   Consistency Review: G. E. Dorffer Completion Date: 10JUNE2019

9. Technical Review and USQ Screening:
   Technical Review/USQ No.: TRP-SS-2019-00160 Date: 6-21-2019

10. CRP / Revision Approvals. (Must be signed before further approvals):
    Safety Doc. Mgr: J. M. Bricker Signature: Date: 6-11-19
    Mgr. Design Authority: E. J. Freed Signature: Date: 6-2-19

11. FOSC Review/Approval:
    FOSC Chairman: Joel Cantrell Signature: Date: 6/25/19
    Implementation Checklist Required? □ Yes □ No
The design grout production operations rate is about 180 gpm. The nominal grout production operations rate is about 150-160 gpm. The composition of saltstone (grout) consists of salt solution or IW, cement, slag, and thermally beneficiated flyash.

Saltstone grout is pumped by a positive displacement peristaltic type pump. The speed can be adjusted since power is supplied via a variable frequency drive. The pump speed is modulated to maintain the level in the grout hopper. The pump heads vent to the SHOC. If pump hose failure occurs, any grout or salt solution released into the head is directed to the SHOC. **A conductivity probe is installed in each pump head vent line to the SHOC and alarms when the grout or salt solution from the pump head is directed to the SHOC.** A rupture pin assembly is installed on the discharge side of the grout pump to protect from an overpressurization scenario in the event the grout transfer line becomes blocked. If the rupture pin activates to relieve the internal pressure due to a high pressure in the discharge side of the grout pump, grout material is released and directed to the SHOC. **A conductivity probe is installed in the discharge side of the rupture pin and alarms when the rupture pin has actuated or in the event the rupture pin has severely leaked into the body.** During process shutdown, liquid feed transitions to IW, and then the mixer, the grout hopper, the grout pump, and connecting valves and piping of the system are flushed with IW from the CCBT or PW from the Process Water Tank to remove residual grout from the system. Transitioning to IW minimizes the amount of salt solution that would be otherwise pumped to the SDU. The flush of the system is directed to the SDU to minimize the transfer of insoluble grout solids to the SSRTs or SFT. Near the end of the flushing operation, the flush is redirected to an SSRT or the SFT by a four-way valve that is a part of the Pig Launching System, and a pig is launched to clean the grout transfer line that runs to the SDU.

The pig discharged from the launcher enters the grout transfer line through a four-way valve, which has two positions. The first position (grout transfer) aligns the grout pump discharge with the grout transfer line to the SDU and aligns pig launcher #1 with an SSRT or the SFT. The second position (pig launch) aligns pig launcher #1 with the grout transfer line to the SDUs and aligns the grout pump discharge with an SSRT or the SFT. Pig launcher #2 has the same two positions except the second position is aligned to the SFT only.

The system is designed with software logic to stop the dry and liquid feeds on certain abnormal conditions (e.g., high level in the grout hopper). The software actuates a condition called ‘setback’ where the dry feed to the mixer is stopped and liquid feed to the SDU is stopped after a delay to allow a flush. During the setback condition, the mixer and grout pump continue to operate and salt solution is recirculated to the SSRTs (or alternatively to the SFT).

Mixing and transfer operations are monitored and controlled via the DCS. The DCS is located in the CCR and is the primary interface between the operator and facility hardware. The mixing and transfer process is normally controlled in an automatic fashion; if abnormal conditions arise, the operator can assume manual control over the various processes.

### 2.5.2.4 Saltstone Disposal

Grout is pumped via a grout transfer line from the process area to either SDU 3 or 6. For SDU 3, the saltstone grout discharges into the approximate center of the SDU cell and has an outward, self-leveling tendency. For SDU 6, the grout has multiple discharge locations (only one is used at a time) and has the same outward, self-leveling tendency. Discharge of the grout and filling of