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WASTE ACCEPTANCE CRITERIA FOR LIQUID WASTE TRANSFERS TO THE TANK FARMS (U)

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Revision History

Rev. 0 – 1/13	**Initial Issue** Revision 0 supersedes X-SD-G-00001
Rev. 1 – 6/19	**Revision 1 incorporates changes made to Tank Farm DSA and X-SD-G-00001 since Rev. 0:** • **Update headings to more closely align with format recommended by ENG.08** • **Section 10.1: Added clarification as to why analytical uncertainty is not required for corrosion** • **Section 10.2.2: Revised HGR section as a result of U-ESS-G-00007** • **Section 10.4: Added new Table 2 to define dose conversion factors to use when calculating IDP** • **Section 10.11: Updated to be consistent with current DSA** • **Section 10.8: Added Table to include list of analytes that should be included in stream characterization to Tank 50** • **Deleted Attachment 13.1** • **Deleted reference to the 2F evaporator**
Rev. 2 – 10/19	• **Added statement to Section 2.2 that influent transfers to MCU are isolated**

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Requirement: This document meets the requirement of the following:

• Administrative Control (A/C) 5.8.2.13	• Administrative Control 5.8.2.32
• Specific Administrative Control (SAC) 5.8.2.15	• CSTF DSA 5.7.1
• SAC 5.8.2.21	• CSTF DSA 6.5.2
• SAC 5.8.2.25	• CSTF DSA 3.4.1.5.2
• SAC 5.8.2.42	• U-ESS-G-00007

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1 Purpose

Liquid high level waste received into the Tank Farms is held in interim storage in underground tanks that range in capacity from 0.7 to 1.3 million gallons. Henceforth, the use of the terms “Tank Farm (TF)” and “Concentration, Storage and Transfer Facilities” (CSTF) are defined to include the 299-H Tank Farm Maintenance Facility, F and H Tank Farms and the interim storage tanks and their associated systems, unless specifically noted otherwise. Typically, fresh waste is transferred into a receipt tank where the insoluble solids (sludge) are allowed to settle. The supernatant liquid is decanted and then transferred to an evaporator for volume reduction. Evaporator overheads are collected and processed through the F/H Effluent Treatment Project (ETP) and then are discharged to an outfall. The tank farm evaporator bottoms are transferred to a concentrate receipt tank, where the contents are cooled to crystallize the salts. The remaining solution is recycled as evaporator feed and the cycle repeated until as much water as possible has been removed. In this fashion, the overall volume of the waste is reduced by approximately 60-70%. Saltcake and sludge fractions have, for the most part, been segregated. The major radionuclide in salt waste is ^{137}Cs while the actinides and the rest of the fission products accumulate in the sludge. Major chemical components include the NO_3^-, NO_2^-, OH^- and salts of Na in the saltcake, and oxides and hydroxides of Fe, Mn, and Al in the sludge.

Eventually, the waste will be removed from the waste tanks and processed into feedstock either for the Defense Waste Processing Facility (DWPF), Salt Waste Processing Facility (SWPF) or for the Saltstone Production Facility (SPF) for the purpose of tank closure. Sludge in the waste tanks will be slurried and transferred into Tank 40 or Tank 51 for sludge processing. The residual sludge solids will then be washed to reduce the concentration of soluble salts in the sludge slurry. Washing consists of several cycles, each including the steps of wash water addition, sludge suspension/mixing, sludge settling, and decanting the spent wash water. Washed sludge will then be transferred to the DWPF for processing into glass for final disposal. Salt waste will be dissolved, blended into batches that will be fed into the SWPF for actinide and cesium removal.

Management of the liquid radioactive waste (i.e., interim storage and processing operations) requires:

- safe disposition of waste in the TF tanks;
- safe operation of Tank Farm facilities (e.g., evaporators);
- understanding the impact of new wastes on existing inventories prior to their acceptance;
- compliance with feed requirements for downstream and processing facilities (e.g., SWPF, DWPF, Saltstone, and ETP)
- certification of solid low level waste (generated as a result of Tank Farm activities) for disposal in the E-area Solid Waste Disposal Facility (SWDF);
- compliance with environmental permits and regulations;
- compliance with all associated facility Safety Basis (SB) (e.g., Tank Farm, SWPF, DWPF, SPF, etc.)

All waste transferred to the Tank Farms for interim storage must be compatible with existing equipment and facilities, and must remain within the CSTF SB safety envelope. As the site mission evolves and generators change their processes, waste characteristics are also expected to change. Because of the potential for waste variability, formalized control of waste being transferred into the Tank Farm is needed.

The criteria presented in this document provide the controls to satisfy the requirements listed above. To that end, this document includes:

- the criteria and the basis for determining the acceptability of waste to be transferred to the TF such that
  (a) interim storage or processing of the waste will be in compliance with applicable safety, environmental, and regulatory requirements and Department of Energy (DOE) Orders; and
  (b) the waste composition will meet the downstream facilities' (e.g., SWPF, DWPF, SPF and ETP) feed requirements;
- the methods for reviewing and approving the acceptability of new waste streams, and for accepting waste streams that deviates from the specific criteria (Section 8);
- the identification of WAC sections that are credited in the CSTF SB.

This document does not include the requirements for performing inter-tank transfers within CSTF. Inter-tank transfer requirements are identified in other Technical Safety Requirements (TSR) Administrative Control Programs such as the Transfer Control Program.

2 Scope

This document identifies the requirements and specifications that must be satisfied by the waste generators for direct waste transfers to the Tank Farm. These requirements are applicable to all organizations and facilities that directly transfer waste to the Tank Farm. This includes, but is not limited to, waste generated in the following facilities:

- H-Canyon and Outside Facilities
- Nuclear Materials Management
- DWPF
- ETP
- Savannah River National Laboratory (SRNL)
- SWPF
- Analytical Laboratories
- Off-site facilities
- Other on-site facilities

2.1 Tank Farm WAC

All liquid waste directly transferred into the Tank Farm waste tanks must satisfy the WAC defined in the following sections. This includes chemicals that are added to a waste tank for use as a special cleaning solution. Waste that is transferred through an intermediate facility for subsequent transfer to the Tank Farm must also satisfy these WAC at the time of discharge to the Tank Farms (i.e., the intermediate facility that directly transfers the waste to the Tank Farm is responsible for assuring transfers from other facilities will not prevent them from complying with the WAC).

Waste generators are required to document their Waste Compliance Plan (WCP, refer to Section 5), including the waste characterization and controls that ensure the waste satisfies the WAC. Most importantly, the WCP must clearly identify the controls protecting the Tank Farm SB and the maintenance of these SB controls.

2.2 CSTF Technical Safety Requirements

[*A/C* SAC 5.8.2.15]

The WAC Program is credited in the SB with ensuring that the composition of waste streams received into the facility is within analyzed limits. Waste streams received into the facility shall comply with the limits/requirements (accounting for analytical uncertainty, as required) for inhalation dose potential, fissile material, fissile poisoning, organic contribution to flammable vapors, heat generation rate, hydrogen generation rate, and Modular Caustic Side Solvent Extraction Unit (MCU) Hazard Categorization. Waste streams not bounded by the analyzed isotopic and chemical inventory assumptions shall not be accepted unless an Unreviewed Safety Question (USQ) has been performed and approved [**1**].

Safety Basis (Documented Safety Analysis [DSA] and Technical Safety Requirements [TSR]) related requirements are identified by placing the specific requirement referenced in brackets and bold text (e.g., **[*A/C* SAC 5.8.2.15]**).

The salt solution feed from Tank 49 is currently isolated from the MCU, and therefore the MCU Hazard Category, Inhalation Dose Potential and Cs-137 limits do not need to be evaluated as part of the salt batch qualification process.

2.3 Generators Safety Basis

Each generator must recognize the TF WAC Program in their SB. A section should be added to demonstrate the importance of the Tank Farm WAC Program [1].

3 Terms, Definitions, Acronyms

Regular Irregular Special	- the three categories of waste (refer to Section 6.1)
Minimum Complete	- the two levels of characterization (refer to Section 6.2)
A/C	- Administrative Control
CSTF	- Concentration, Storage, and Transfer Facility
DBP	- Dibutylphosphate
DIRT	- Data Integrity Review Team
DF	- Decontamination Factor
DOE	- Department of Energy
DSA	- Documented Safety Analysis
DWPF	- Defense Waste Processing Facility
EEC	- Environmental Evaluation Checklist
ECA	- Environmental Compliance Authority
EF	- Equivalency Factor
EPA	- Environmental Protection Agency
ERD	- Emergency Response Data
ESP	- Extended Sludge Processing
ETP	- Effluent Treatment Project
FOSC	- Facility Operations Safety Committee
GCO	- Generator Certification Official
GPE	- General Purpose Evaporator
GRM	- Gas Release Mode
HC	-Hazard Category
HEME	- High Efficiency Mist Eliminator
HEPA	- High Efficiency Particulate Air
HLW	- High Level Waste
FTF/HTF	- F-Area Tank Farm, H-Area Tank Farm
ICRP	- International Commission on Radiological Protection
IDP	- Inhalation Dose Potential
IW	- Irregular Waste (refer to Section 6.1)
LEL, LFL	- Lower Explosive Limit, Lower Flammability Limit
LWEE	- Liquid Waste Environmental Engineering (Environmental Services Section)
LWF	- Liquid Waste Facilities

LWGR	- Liquid Waste Generator Representative (refer to Sections 4.2)
LWO	- Liquid Waste Operations
MCU	- Modular Caustic-Side Solvent Extraction Unit
NCSE	- Nuclear Criticality Safety Evaluation
OSHA	- Occupational Safety and Health Administration
PA	- Performance Assessment
PDD	- Program Description Document
PR/STAR	- Problem Report, Site Tracking Analysis and Reporting
PVV	- Process Vessel Ventilation
RCRA	- Resource Conservation and Recovery Act
RCT	- Recycle Collection Tank
RW	- Regular Waste (refer to Section 6.1)
SAC	- Specific Administrative Control
SB	- Safety Basis
SCDHEC	- South Carolina Department Health and Environmental Control
SDU	- Saltstone Disposal Unit
SIRIM	- Site Incident Reporting and Issue Management (ref: manual 9B)
SPF	- Saltstone Production Facility
SRNL	- Savannah River National Laboratory
SRS	- Savannah River Site
SW	- Special Waste (refer to Section 6.1)
SWCP	- Special Waste Compliance Plan
SWDF	- Solid Waste Disposal Facility (i.e., the E-Area Vaults)
SWPF	- Salt Waste Processing Facility
TBP	- Tributylphosphate
TPB	- Tetraphenylborate
TF	- Tank Farm
TFE	- Tank Farm Engineering
TFO	- Tank Farm Operations
TCLP	- Toxicity Characteristic Leaching Procedure
TRU	- Transuranic
TSR	- Technical Safety Requirement
USQ	- Unreviewed Safety Question
USQS	- Unreviewed Safety Question Screening (ref: procedure 1.05 in manual 11Q)
WAC	- Waste Acceptance Criteria
WCP	- Waste Compliance Plan (refer to Section 5)
WCS	- Waste Characterization System

4 Responsibilities

4.1 Tank Farm Engineering (TFE) WAC Cognizant Engineer

is responsible to:

- maintain the WAC, including reviews and revisions as needed
- co-prepare and co-approve the WAC implementation checklist for each WAC revision
- advise all waste generators on the WAC requirements, including the relation to TSR, and other technical bases
- co-approve the waste generator's WCP
- conduct Technical Reviews (USQ review) of the waste streams only if they deviate from the WAC
- assign a waste stream number to all approved waste streams
- revise the Approved Waste Stream List (i.e., Emergency Response Data [ERD][46]) to include any new waste streams approved for receipt in the TF
- evaluate Waste Stream Dose Concentrations (ERD) for new waste streams or for waste stream characterization revisions
- coordinate with the Waste Characterization System (WCS) Program Description Document (PDD) owner, or Data Integrity Review Team (DIRT) chairperson, monthly on Work Group WG08 updates if there have been transfers to the TF [38]
- document and review the waste generator's self-assessment programs for compliance with the WAC and WCP
- evaluate the impact of a WAC non-compliance, assist the investigation (e.g., PR/STAR, SIRIM) and address the impact to the Tank Farm WAC Program [1]

4.2 Waste Generator and Liquid Waste Generator Representative (LWGR)

is responsible to:

- develop, document, co-approve, and implement a WCP (refer to Section 5)
- clearly identify items within the WCP that protect CSTF SB requirements and the program for maintaining controls for these items (e.g., procedures, procurement specification)
- designate their LWGR, who serves as the primary contact with TF for all communications regarding these responsibilities
- prepare all waste for transfer to the TF so that all WAC requirements are met
- verify that any procedure changes associated with a waste stream do not impact any WAC/WCP agreements
- input all characterization and transfer information into the Wisdom Workgroup WG08 as agreed to in the WCP and maintain records demonstrating compliance with the WAC and WCP
- notify the TFE WAC Cognizant Engineer when a special transfer is terminated (e.g., completion of PVV flush)
- include compliance with their WCP as part of a self-assessment program
- finance any additional evaluations or other measures required for the Tank Farm to accept special waste
- report a WAC non-compliance to TF and assist the investigation (e.g., PR/STAR, SIRIM)
- finance any required studies to develop technical bases for receipt of the waste
- finance any corrective action resulting from the generator's failure to meet the WAC
- communicate with WCS PDD owner, or DIRT chairperson, on WG08 updates regarding significant changes to volume of existing waste streams or, any other non-routine WG08 updates

4.3 Tank Farm Operations (TFO)

is responsible to:

- co-approve the WAC and each WCP, particularly the operational aspects of all waste transfers
- authorize the receipt of actual waste transfers from generators

4.4 Environmental Compliance Authority (ECA)

is responsible to:

- advise TFE and all waste generators on the WAC requirements, assuring compliance with environmental permits, local, state, and Federal laws and regulations
- co-approve the WAC and review WCP deviation requests
- notify the Generator Certification Official (GCO) and the characterization engineer (supporting Tank Farm Solid Waste Disposal) of possible impacts to the Tank Farm Solid Waste streams as a result of WAC changes or changes to the input streams.

5 Waste Generator's Compliance Plan and TF Approval

Each waste generator shall develop, implement and maintain an approved compliance program, as described in a formal WCP. The WAC and WCP combine to bridge the interface between the tank farms and the waste generator, ensuring that waste transferred to the Tank Farms can be safely stored and processed for disposal. At a minimum, the WCP document shall:

- describe the transfer volumes and frequencies to the Tank Farms
- describe the chemicals (and radionuclides if applicable) used in the process generating the waste (i.e., species that could affect the waste composition)
- describe the waste stream in terms of complete characterization (refer to Section 6)
- technically justify deviations from any WAC requirements
- describe activities that ensure compliance with the WAC, including any required waste processing (e.g., the generator may need to decant and/or evaporate to remove any organic material)
- identification of "SB" controlled requirements (see section 2.2)
- describe the self-assessment program that assures compliance with the WCP
- describe waste minimization activities (e.g., acid recovery and volume reduction by evaporation, reduced consumption of chemicals)
- describe any future activities that will validate and/or improve the characterization (e.g., samples)

The originator, Waste Generator and Receiving Facility Technical Reviewer(s), Waste Generator Engineering Manager, Waste Generator Facility Manager, Receiving Facility Engineering Manager, Environmental Support Services, and Receiving Facility Manager(s), at a minimum, must approve the new/revised WCP/Special Waste Compliance Plan (SWCP), including the Implementation Checklist, if necessary.
The WCP may subdivide the major waste streams (listed in Section 6.1) on any appropriate basis provided each waste stream is characterized separately. As described in Section 6.2, "process knowledge" and sample analysis can be combined to characterize a waste stream.

TFE shall review the WCP, particularly the waste characterization versus the specific acceptance criteria described in Section 10.

Any new waste stream or WCP change requires review and approval by the Tank Farm; nominally ***6 weeks*** before the waste is to be transferred to the Tank Farms. Calculations performed to demonstrate WAC compliance shall meet the requirements of E7 procedure 2.31A [47]. Any waste stream generated from a discussed activity in the approved WCP must be characterized (and the characterization included as an attachment, or referenced, in the WCP). The final WCP shall be in place before transfer of a new or modified waste stream is allowed.

An evaluation, by TFE, of the flammability impact to the proposed waste receipt tank shall be completed prior to TFE approval of any WCP for a special waste stream.

Basis

The WCP is an agreement between the waste generator and the Tank Farm that documents the generator's responsibilities to prepare the waste for interim storage, processing, and eventual disposal.

6 Waste Stream Categories and Characterization

Waste to be sent to the Tank Farm shall be characterized sufficiently for TFE to demonstrate that receipt of the waste stream will not cause the receiving process or tank to exceed the inputs/assumptions used in the CSTF Safety Basis [2]. All sample analyses used to demonstrate compliance with the requirements for organic flammable species, inhalation dose potential (IDP), and criticality safety must include the analytical uncertainty of those measurements (2 sigma) [3].

Note: TFE will evaluate the waste stream characterization to ensure that any impacts on the Tank Farm Safety Basis are recognized, evaluated and approved. For example, the DSA uses certain inhalation dose potential compositions and inventories (e.g., Ci/gal or rem_{inh}/gal).

Basis

Waste transferred to the TF must not cause the receiving pump tank or waste tank to exceed the bounding composition allowed in the Safety Basis. As the Savannah River Site missions change and evolve, the waste transferred to the Tank Farm may be more variable than historically observed. Similarly, the Safety Basis must be updated periodically as changes occur. Relative to the Safety Basis, the impact of each waste stream on the existing waste tank inventory must be known.

TF's evaluations use data for several of the radionuclides included in the waste stream characterization (refer to Section 6.2).

6.1 Categories

Three categories of waste streams are defined to determine the characterization and reporting requirements. The three categories are:

- **Regular Waste** (RW) has a consistent composition -- both the species present, and their concentrations, are relatively constant (over time).

  Since a given RW stream has little variation in composition, that characterization is sufficient to evaluate the stream's acceptability. However, a full characterization may be required for new waste streams never received in the tank farms. Reporting the volume of each waste stream transferred is sufficient to allow tracking the receipts (and the waste tank inventories) of each species.

  A RW stream will have a consistent composition over time unless the flowsheet is altered by the generator. The volume of such waste streams may be large and transfers to the Tank Farms may be frequent, helping to minimize the variability in composition. For example, "Purex low heat process waste" was generated continuously by the production process, and varied as a function of irradiation time and the timing of a transfer relative to other operations that generate low heat waste (e.g., decontamination waste).

- **Irregular Waste** (IW) has a variable composition -- the concentrations of various species vary within some bounds, but the same species are present (over time).

  Since a given IW stream contains the same species and their concentrations can be bounded, that bounded composition is sufficient to evaluate the stream's acceptability. However, to permit tracking the receipts (and the waste tank inventory), the volume and the composition of each batch or the concentration of a selected "indicator" species must be reported for each transfer.

  An IW stream may be generated frequently or intermittently, but it has a potential for large composition variations. The species in a particular IW may be the same as those present in the RW of that process, but the concentrations vary widely (e.g., from batch to batch). No new species/process chemicals are introduced.

- **Special Waste** (SW) has a highly variable composition -- either different species are present, or their concentrations may vary too widely to be bounded satisfactorily. Special waste may also encompass material that is non-routine (or irregular) and/or not necessarily waste.

For SW, species present may have significant variation in composition from batch to batch or the waste may contain constituents that are not present in waste normally received in the Tank Farms. As such, characterization of each batch is required to evaluate the stream's acceptability. Also, the composition and volume of each transfer must be reported in more detail to allow tracking the receipts and waste tank inventory. In this context, the term "transfer" may refer to individual waste transfers, or it may apply to all transfers from a special process campaign. The appropriate scope shall be defined by the generator in the WCP.

These wastes may be generated as part of special activities such as addition of radioactive liquid chemicals to a waste tank or use of a special cleaning solution, or in a process where the presence of species changes from batch to batch, or from one-time activities (e.g., facility decommissioning and closure).

The key to categorizing a given stream as RW, IW, or SW is the variability in species that are present and their concentrations.

The generator's WCP will define their streams and assign the appropriate category to each.

6.2 Characterization

Characterization shall be based on a combination of (1) process knowledge and (2) analysis of process samples. When sufficient analyses are available for a species, then they should be used for the characterization. When process knowledge is used for some species and analyses are used for others, then the validity of the process knowledge may be corroborated by following a similar reasoning for the "analyzed" species, and comparing that process knowledge to the sample analyses. The characterization should be presented in terms of concentrations in the waste stream to be transferred to the TF.

Table 1 provides the characterization requirements for influent waste streams to the TF.

Table 1 Characterization Requirements

Type of Waste Compliance Plan	Complete Characterization	Periodic Characterization
Regular WCP	Required	Required Quarterly or As Defined in WCP
Irregular WCP	Required	Frequency Defined in WCP
Special WCP	Required	Frequency Defined in WCP

A complete characterization is required prior to the approval of all waste streams. The periodic characterization, or minimum characterization is required quarterly, or as defined in the generator's WCP for all regular waste streams; the frequency of the periodic characterization for all irregular and special waste streams is defined in the agreement obtained in the generator's WCP for that waste stream. The waste generator will be responsible for ensuring their waste streams are appropriately characterized. Waste generators sending to Tank 50 will characterize their waste streams to comply with the current revision of the Saltstone Production Facility (SPF) WAC [6]. The minimum constituents required for SPF WAC characterization is provided in Section 10.8.

As noted in Section 5, the generator's WCP will document the appropriate characterization bases (both complete and periodic) and will be approved by TFE. As is discussed in Section 8, the WCP may take exception to a characterization requirement and provide a defensible rationale and/or alternative.

Changes in a waste stream's characterization are to be submitted for review and approval by revising the WCP.

The quarterly requirement to characterize RW streams may be relaxed if the generators' procedures analyze for major constituents (e.g., isotopes for criticality and inhalation dose, or constituents that have concentrations close to downstream facility or process limits, etc.) in waste streams prior to transfer to TF. The generator's WCP will define and justify the sampling frequency if the frequency is not quarterly.

Additional characterization may be required in order to meet the requirements of Section 10.8 of the WAC. Characterization needed to satisfy downstream and processing facility requirements will be required prior to the approval of the generator's WCP.

Characterization information should be provided at least six weeks prior to the planned transfer to the Tank Farms. Transfer information should be provided within two weeks of the transfer or as agreed upon in the WCP.

Basis

A wide variety of liquid waste is received into the CSTF, and based on the definitions in Section 6.1; these wastes are assigned to a category (i.e., RW, IW, or SW).

RW is typically generated by a facility's ongoing/routine operations. **IW** may be generated in a facility as a result of activities used to improve production (e.g., flushing of process vessels). The use of nitric and oxalic acid solutions for cleaning and decontamination is also considered as generation of IW, even though the salts of these acids are present in normal waste. Another example of **IW** is dissolution of High Efficiency Mist Eliminator/High Efficiency Particulate Air (HEME/HEPA) material in the DWPF. Other waste streams may be categorized as **SW** due to their potential for a wide variety of chemical constituents and concentrations. Examples of SW would include the following:

- The use of special flushing/cleaning agents in all facilities will likely introduce species that are not present in RW streams.
- Miscellaneous streams from the H-Canyons could include product solutions or new fuel types, which would require detailed characterization and evaluation before transfer to the Tank Farms.
- The use of different chemicals for experiments or analytical methods within the site laboratory facilities could generate waste in which the species inventory will vary significantly from batch to batch, depending on programs being performed at the time. Note that a lab waste stream could well be considered RW, depending on the consistency in its operations and waste composition (over time).
- Decontamination, decommissioning, and closure of site facilities could generate waste solutions drastically different than routine high level waste. Each batch of these wastes will require evaluation of impact to the Tank Farms, and are categorized as SW.

Characterization of influent waste streams into the Tank Farms must be tracked throughout the CSTF. The inclusion of specific species in the characterization is based on requirements discussed in Section 10. Species that can cause upsets with respect to these requirements must be identified so that a strategy for handling these species can be developed.

7 Documenting Waste Transfers to the Tank Farms

[*A/C* SAC 5.8.2.15 and Admin Control 5.8.2.32]

The waste generators will input characterization and transfer information into the WG08 folder, HLW-WRT to provide easy tracking. In addition, the generators shall perform an independent verification of data.

When transferring waste to the Tank Farms, generators shall comply with the criteria in Section 5.7.1 of the CSTF DSA (refer to Section 10.11 of this document). [3]

For generators that send measurable sludge quantities, the entries to WG08 shall include data adequate to determine the total sludge amount added. The generator's WCP will include description of the data supplied to meet the determination needs.

Basis

The Tank Farms SB has an administrative requirement to have a WAC Program to safely receive waste [1, 3]. To meet the future processing requirements the characterization and transfer information will be recorded in WG08.

8 Deviations from the WAC Requirements

[*A/C* SAC 5.8.2.15]

Programmatic controls shall ensure that waste streams to be received into the CSTF (or transferred through the CSTF from an outside sender) is within the analyzed isotopic and chemical inventory, and physical condition (e.g., temperature) requirements of the Tank Farm WAC and that verifications are performed in accordance with the applicable CSTF-approved Waste Compliance Plan (or other approved engineering document). If the material does not meet the WAC requirements, an USQ review (or equivalent) shall be performed and approved by TFE prior to transferring the material [3].

A waste generator may take exception to anything in this WAC (i.e., any deviation can be proposed), and such deviations will be documented in the generator's WCP. In this context, the terms "deviation", "exception", and "exemption" have the same meaning. As discussed in Section 5, TF's approval of the WCP will thus include any requested deviations.

For transfer of a particular solution that is outside one or more of the specific WAC requirements in Section 10, depending on the circumstance, a deviation may be possible, particularly for a limited volume of the waste. For example, the existing contents of a waste receipt tank may be "credited" for "blending" the composition of a proposed waste. TF and the waste generator will jointly determine if any additional controls are needed to ensure that the waste can be safely received, managed and eventually processed by DWPF, SPF, SWPF or ETP. For example, additional mitigating measures or studies may be necessary to receive the waste.

When deviating from the WAC, generators must submit a written request, which must be approved by TFE and TFO Managers after a USQ has been performed against the proposed activity and approved by the Facility Oversight Safety Committee (FOSC). When generators deviate from their WCP, a written evaluation must be performed on the proposed activity which must be approved by TF Engineering and Operations Managers. FOSC approval is not required for WCP deviations that do not impact the WAC. Generators must provide a basis/justification for why a deviation (regardless of whether it is a WAC or WCP deviation) is acceptable in their WCP. WAC deviations must be clearly identified and summarized in the "Deviation" section of the WCP.

Note that a WAC deviation may also trigger other administrative systems (e.g., Safety Basis change, procedure changes, and set point changes).

Basis

The activities that result in the generation of a different waste composition, and the act of receiving that waste into the Tank Farms, fall within the scope of a "Proposed Activity" [2,3], thus, "Technical Review" procedures are the most appropriate means of evaluating and approving the transfer of a waste stream with a different composition.

9 Recovery from a Non-Compliance

The LWGR is required to immediately inform TF Engineering and TFO verbally and in writing of any requirements which have not been satisfied (e.g., due to a process upset, an inadvertent transfer). In conjunction with TFO and TF Environmental Engineering (ECA), TFE will determine the actions to be performed by the Generator before waste can be (or can continue to be) accepted in the TF.

Note: the PR/STAR, and/or SIRIM procedures will be invoked as appropriate.

Basis

For waste that does not comply with the specific requirements of the WAC, a strategy must be developed for safe management and future processing. The purpose of the criteria is to ensure that all waste received conforms to requirements for interim storage, processing, and eventual disposal.

10 Specific Criteria for Liquid Waste Receipts into the F/H Tank Farms

This WAC identifies chemical and radionuclide requirements and other specifications that must be satisfied by the waste generators for waste transfers to the Tank Farms.

Specific requirements detailed below govern the presence and allowable concentrations of several species. They incorporate many safety and regulatory considerations for the safe management and processing of waste within the Tank Farms (e.g. corrosion prevention [4]). Safety Basis (DSA and TSR) related requirements are identified by TSR Administrative Control number or relevant DSA section in the section's heading. TFE's review of a generator's WCP will evaluate the appropriate implementation of SB identified items. Specifications also result from feed requirements of the downstream processes (e.g., SWPF, DWPF, Saltstone [6, 7, 44], and ETP [9]). Some of the species and/or properties appear in more than one requirement; however, the most conservative limit should be applied.

10.1 Requirements for Corrosion Prevention

The TF waste tanks and cooling coils within the tanks are constructed of carbon steel, and are susceptible to nitrate induced stress corrosion cracking, general corrosion and pitting corrosion. To prevent unacceptable rates of corrosion, waste solutions in the Tank Farms must satisfy the specifications in sections 10.1.1-10.1.4. A waste generator's WCP will ensure that waste solutions transferred into the TF also satisfy the specifications in sections 10.1.1-10.1.4. A single transfer that does not meet the specifications in sections 10.1.2-10.1.4 is not automatically considered a WAC non-compliance, but will require the LWGR to notify TFE in order to evaluate the impact on the receipt tank's chemistry. In cases where a planned transfer is outside the specifications of Sections 10.1.2-10.1.4, transfers may proceed where the impact on receipt tank chemistry has been evaluated and documented prior to receipt. The specification in section 10.1.1 is a Tank Farm SB requirement and waste transfers into the Tank Farms must meet this requirement.

As corrosion is a relatively slow phenomenon and limits are based on general chemistry regimes, analytical uncertainty is not required to be applied when demonstrating compliance with corrosion limits [3].

10.1.1 Minimum pH of Waste

[*A/C* CST Admin Control 5.8.2.13 and DSA 6.5.2]

pH > 12

Basis

This is a TSR Administrative Control which requires limits on pH [1,4]. A minimum pH of 9.5 for influents into the waste tanks was established in the Corrosion Control Program [4]. A minimum pH of 12 will bound the PDD requirement that transfer lines with ‘low’ points be flushed with inhibited water unless another waste transfer is planned within the next 5 days. The Tank Farm DSA 6.5.2 requires an alkaline solution (pH>7) to protect criticality. The requirement of a pH>12 also protects this Tank Farm Criticality Safety Basis [10].

Solutions with a pH below 7 cause general corrosion of carbon steel. To prevent general corrosion, solutions transferred to the tanks must have a pH above neutral, and the specification of pH above 12 is judged to provide adequate margin to account for error in sampling and analysis. The waste tank corrosion chemistry sampling program corrects for inhibitor depletion (e.g., hydroxide depletion by CO_2 absorption), and also confirms the generator’s pH controls and inhibitor additions.

10.1.2 Minimum Inhibitor Contents for all Waste Generators

Including DWPF Recycle when Stored Below 40°C

[*A/C* CST Admin Control 5.8.2.13]

For 5.5M < $[NO_3^-] \le 8.5$ M:		$[OH^-] \ge 0.6$ M
	<u>and</u>	$[OH^-] + [NO_2^-] \ge 1.1$ M
For 2.75 M < $[NO_3^-] \le 5.5$ M:		$[OH^-] \ge 0.3$ M
	<u>and</u>	$[OH^-] + [NO_2^-] \ge 1.1$ M
For 1.0 M $\le [NO_3^-] \le 2.75$ M:		$[OH^-] \ge 0.1 * [NO_3^-]$
	<u>and</u>	$[OH^-] + [NO_2^-] \ge 0.4 * [NO_3^-]$
For 0.02 M < $[NO_3^-] \le 1.0$ M:		$[OH^-] \ge 1.0$ M
	<u>or</u>	$[NO_2^-] \ge 1.66 * [NO_3^-]$
For $[NO_3^-] \le 0.02$ M:		$[OH^-] \ge 1.0$ M
	<u>or</u>	$[NO_2^-] \ge 0.033$ M

Note: all concentrations are in moles/liter, and $[OH^-]$ refers to free hydroxide.

Basis

The Corrosion Control Program requires limits on OH^-, NO_2^-, and NO_3^- to ensure that the tank chemistry is controlled to minimize corrosion of tank walls, cooling coils and transfer lines [1, 4]:

- The specification for free hydroxide concentration through the entire range of nitrate composition ensures that the alkalinity of the waste is sufficiently high to prevent general corrosion.
- The combination of nitrite and hydroxide as inhibitors provides protection against nitrate induced stress corrosion cracking, which can occur for nitrate concentrations above 1M. The nitrate ion is, by far, the predominant aggressive species. The cracking aggressiveness of solutions increases as the nitrate concentration increases, requiring more corrosion inhibitor to be present.
- The concentrations of nitrite and hydroxide provide protection against pitting corrosion, which is the main corrosion mechanism for solutions with nitrate concentrations below 1M in carbon steel tanks. The limits are based on either nitrite or hydroxide acting alone to prevent pitting. No pitting has been observed for a free hydroxide concentration above 1M. Because no data have been developed at lower hydroxide concentrations, the value of 1M is used. For nitrite inhibition, the minimum concentration was developed from the amount of nitrite needed at a minimum hydroxide concentration. The nitrite concentration specified in the limit was determined for a waste temperature of 40°C. Waste temperature in uncooled tanks in which dilute waste is stored has been observed to only reach about 30-32°C during the summer months.

The waste tank corrosion chemistry sampling program corrects for inhibitor depletion (e.g., hydroxide depletion by CO_2 absorption), and also confirms the generator's pH controls and inhibitor additions.

DWPF recycle waste may use the limits given above as long as the receipt tank's supernate temperature is not greater than 40°C. These limits may also be used for a receipt tank that will have a resulting nitrate concentration greater than 1 M [11].

10.1.3 Minimum Inhibitor Contents for Waste Generated by DWPF When Stored at Temperatures in Excess of 40°C [*A/C* CST Admin Control 5.8.2.13]

For $[NO_3^-] \geq 1.0$ M:		follow Section 10.1.2
For $0.1\ M \leq [NO_3^-] < 1.0$ M:		$[OH^-] \geq 1.0$ M
For $0.01\ M \leq [NO_3^-] < 0.1$ M:		$[OH^-] \geq 0.5$ M
	and	$[NO_2^-] \geq 3.17 * [NO_3^-] - 0.0192$
For $[NO_3^-] < 0.01$ M:		$[OH^-] \geq 0.5$ M
	and	$[NO_2^-] \geq 0.0013$

Note: all concentrations are in moles/liter, and $[OH^-]$ refers to free hydroxide.

Basis

The Corrosion Control Program requires limits on OH^-, NO_2^-, and NO_3^- to ensure that the tank chemistry is controlled to minimize corrosion of tank walls and transfer lines [1, 4]. This requirement is based on analytical experiments with simulated DWPF recycle waste [12, 13, 41] as well as an evaluation of the temperature dependence of inhibitor limits [11]. Nitrite and hydroxide in the DWPF recycle will provide protection against pitting corrosion. The recycle volume can be as much as 3 Mgal/yr and is collected from various unit operations throughout the DWPF. The waste is collected and transferred to the Tank Farm (e.g., Tank 22) in ~8,000 gal batches. The nitrate concentration is expected to vary widely, up to a concentration of 1M. The specified concentrations of inhibitors will provide adequate protection for the composite recycle stream. The waste tank corrosion chemistry sampling program corrects for inhibitor depletion (e.g., hydroxide depletion by CO_2 absorption), and also confirms the generator's pH controls and inhibitor additions.

10.1.4 Maximum Concentrations of Corrosive Species [*A/C* CST Admin Control 5.8.2.13]

The waste's supernate phase is limited to (these concentrations may occur simultaneously):

- $[Cl^-] \leq 0.11$ M;
- $[F^-] \leq 0.086$ M (the concentration of uncomplexed fluoride);
- $[NO_3^-] \leq 8.5$ M; and
- $[SO_4^{-2}] \leq 0.18$ M.

Basis

The Corrosion Control Program requires limits on SO_4^{-2}, Cl^-, and NO_3^- to ensure that the tank chemistry is controlled to minimize corrosion of tank walls and transfer lines [4]. The maximum chloride and sulfate concentrations reflect the maximum concentrations found in the Tank Farms [14]. The Tank Farm's satisfactory operating history demonstrates that the inhibitor levels specified in Section 10.1.2 are sufficient to prevent corrosion of the waste tanks at these chloride and sulfate concentrations. The limits refer to the soluble phase composition.

The maximum uncomplexed fluoride concentration is specified to prevent corrosion of the carbon steel waste tanks and cooling coils. Fluoride is used in the Separations processes to promote dissolution. The specification is based on corrosion tests for dilute waste solutions (i.e., nitrate concentration < 1.0 M) inhibited with nitrite. The maximum fluoride concentration tested was 0.086 M, and the inhibitor levels specified in Section 10.1.2 for $[NO_3^-]$ less than 1 M were found to prevent corrosion [15].

The maximum nitrate concentration is a Corrosion Control Program limit [4]. This limit prevents addition of waste outside of the range of nitrate concentration for which corrosion inhibitor requirements have been developed.

10.2 Requirements to Prevent Accumulation of Flammable Species [*A/C* SAC 5.8.2.15]

10.2.1 Organic Vapor Control [*A/C* SAC 5.8.2.15]

All sample results reported to demonstrate compliance with the requirements to prevent accumulation of flammable species (organic content) must include analytical uncertainty of 2 sigma, and the uncertainty must be used in any subsequent calculations based on those results [36]. If process operations (e.g. evaporation and decantation) are credited for organic vapor control rather than sample analyses, sample uncertainty is not required for any organic analysis.

Prior to waste streams entering the CSTF, the waste stream shall be evaluated and shown to have less than, or equal to, a 5 % organic contribution to the hydrogen Lower Flammability Limit (LFL) at 100°C [3]. This includes volatile organics as well as ammonia. Although the Tank Farm DSA calculates LFL values at 100°C in the pump tank (so reliance on temperature controls is not needed), generators are still required to transfer waste at no greater than 70°C. Meeting the WAC requirement will require WAC restrictions on generators with the nature and extent of the restriction varying by waste stream. For example, requiring that non-Process Vessel Ventilation (PVV) transfers from the Canyons undergo decanting and evaporation may be sufficient to ensure the 5 % limit is met for a given waste stream [3, 16]. Also, no new sources of flammable material may be added to the waste stream after it has been evaporated and decanted. Waste shall only be excluded from these decanting and evaporation requirements if prior process knowledge has shown it to contain only trace organics (< 5 % hydrogen LFL) without evaporation or an evaluation is performed to ensure the 5% limit is not exceeded. A semi-annual sample for volatile/semi-volatile organics will provide analytical assurance that the organic content of the waste stream will contribute less than 5% hydrogen LFL. Other senders (e.g., DWPF) may require limits on the waste stream constituents (e.g., ammonia).

Canyon PVV flushes may exceed the 5 % limit and be transferred into the Tank Farms if they are evaluated and shown to have:

- Less than, or equal to, a 20 % organic contribution to the hydrogen LFL in receipt pump tank (at 100°C) [3], and
- Less than, or equal to, a 5 % organic contribution to the hydrogen LFL in locations downstream of the receipt pump tank (at 100°C) [3].

The evaluation of effects downstream of the receipt pump tank may take credit for actual facility conditions in showing the organic contribution to the hydrogen LFL is less than, or equal to, 5 %. The required purge flow of receipt pump tanks for transfers exceeding a 5 % organic contribution (up to a 20 % organic contribution) is adjusted to account for the additional contribution of the organics. To transition the flow requirement back to the non-PVV flow requirement, sufficient pump tank flushes shall be performed to reduce the organic contribution to the hydrogen LFL to less than or equal to 5 % (at 100°C) [3]. The number of flushes required shall be determined on a case by case basis by an engineering evaluation of the organic concentrations required to meet the 5 % limit. The engineering evaluation shall be performed using the methodology outlined in Reference 16.

The ammonia concentration in the ETP stream transferred into Tank 50 is limited to 720 mg/L. [17]

Basis

"Organics" as used in the DSA is defined as flammable vapors other than hydrogen contributing to the LFL, including both organic vapors and other flammable vapors. Because of this WAC requirement, the flammability contribution of organics in CSTF locations can be considered bounded by 5 % of the hydrogen LFL without reliance on any temperature controls. The energy contribution of organics to an explosion is accounted for by adding an extra 0.96 vol. % H_2 to the calculated H_2 volume.

Volatile species, both organic (e.g., butanol) and inorganic (e.g., ammonia), can be "driven" from solution by the presence of dissolved salts at high pH. Most of the waste already in the Tank Farms contains higher salt concentrations than the fresh waste streams, so mixing the solutions can force the volatile species into the waste tank vapor space. A limit is required to ensure that the pump tank and waste tank vapor space does not exceed 5% of the hydrogen LFL (exemptions, up to 20% contribution at 100 °C, are allowable if documented by WCP, SWCP, or deviation) under liquid-vapor equilibrium conditions. This excludes the hydrogen generation.

Only occasionally, a few grams of methanol are included in a DWPF recycle batch. Even the maximum amount of methanol that is transferred from DWPF does not contribute to increasing the hydrogen LFL in waste tanks [16]. Thus, the impact of methanol in waste tanks is negligible and, therefore, ignored.

The ammonia limit applied to the ETP influent stream to Tank 50, 720 mg/L, is based on X-CLC-H-00581[17]. This value is greater than the Saltstone WAC and so is an exception to the requirements of 10.8, Requirements to Satisfy Downstream Facility Acceptance Criteria.

<u>Restrictions for DWPF Transfers</u>

The concentration of organics in DWPF's Recycle Collection Tank (RCT) waste stream must be limited to the following in order to restrict the organic contribution to the hydrogen LFL to ≤5% at 100°C in the pump tank: [16]

Strip Effluent: ≤ 20gallons per RCT batch of DWPF recycle [8]
Ammonia: ≤ 60 mg/L in waste tank
Note: the ammonia limit, in addition to protecting the LFL limitation in a pump tank, factors in protecting the ETP receipt limit. Any change to this ammonia limit shall consider the impact on Evaporator overheads compliance with the ETP limit.

<u>Restrictions for Tank 50 Transfers</u>

The maximum Isopar-L concentration for transfer into Tank 50 is 105 ppm [3].

10.2.2 Hydrogen Generation Rate

[*A/C* SAC 5.8.2.15 , 5.8.2.25, DSA 3.4.1.5.2, and U-ESS-G-00007]

The Liquid Waste Generators must ensure that the hydrogen generation from radiolysis for influent waste streams is less than or equal to 4.5E-06 ft^3/hr/gal at 25°C [40].

The hydrogen generation rate for a given waste stream depends on the radioactive decay heat and the concentration of any hydrogen scavengers (e.g., nitrate and nitrite) that may be present in the waste. The hydrogen generation rate, x_{RAD}, is calculated from the radioactive decay heat using the following equation:

Equation 1: $$x_{RAD} = \frac{R_{\beta/\gamma}H_{\beta/\gamma} + R_{\alpha}H_{\alpha}}{10^6}$$

Where:

x_{RAD} = Radiolytic hydrogen generation rate at 25°C, ft^3/hr

$R_{\beta/\gamma}$ = Volume (ft^3) of hydrogen generated per MBTU (10^6 British Thermal Unit) of heat added from beta or gamma decay

$H_{\beta/\gamma}$ = Heat generated by beta and gamma decay, BTU/hr

R_{α} = Volume (ft^3) of hydrogen generated per MBTU of heat added from alpha decay

H_{α} = Heat generated by alpha decay, BTU/hr

The 10^6 in the denominator converts MBTU to BTU.

The values of $R_{\beta/\gamma}$ and R_{α} are dependent on the concentration of nitrate and nitrite in the waste and are given by Equations 2 and 3.

Equation 2 $$R_{\beta/\gamma} = 48.36 - 52.78 * [NO_{eff}]^{1/3} + 14.1 * [NO_{eff}]^{2/3} + 0.572 * [NO_{eff}]$$

Equation 3 $$R_{\alpha} = 134.7 - 82.3 * [NO_{eff}]^{1/3} - 13.6 * [NO_{eff}]^{2/3} + 11.8 * [NO_{eff}]$$

Where:

NO_{eff} = The nitrate concentration plus one-half of the nitrite concentration, mol/L

$$[NO_{eff}^-] = [NO_3^-] + 0.5 * [NO_2^-]$$

The hydrogen generation rate calculated or assumed is for Standard Pressure at an initial temperature (Ti) (e.g., 25°C). Many of the accidents are assumed to occur at elevated temperatures. Therefore, the hydrogen generation rate must be corrected for the higher temperatures.

A flammability evaluation (in accordance with the Flammability PDD [42]) is required as part of the salt batch acceptance process, including maximum expected volumes of ETP and General Purpose Evaporator (GPE) influent streams, to ensure that Tank 50 will remain a Very Slow tank.

The WCP for waste streams received by Tanks undergoing salt dissolution (e.g. Tank 41) that are sludge bearing streams (e.g. DWPF recycle) shall address the total addition of sludge. Each salt dissolution has an accompanying gas release mode (GRM) evaluation. The GRM sets the total amount of sludge that tank may receive.

Basis

The hydrogen generation rate for influent waste into the CSTF is limited to 4.56E-06 ft3/gal-hr. This protects the current maximum HGR for transferable waste at CSTF and maintains margin to account for potential contributions from thermolysis [40].

In the absence of purge ventilation, leakage, or other mitigating factors, hydrogen and organic vapor may accumulate in the vapor space of Tank Farm waste tanks and pump tanks. To prevent the composite gas/vapor from reaching 100% hydrogen LFL (which is 4% of the vapor space volume for the case of hydrogen, alone), administrative controls must be used to monitor the potential hydrogen and organic vapor buildup [3].

Using empirical data relating the volumetric rate of hydrogen generated to the nitrate and nitrite concentration and decay heat present, estimates can be made of the time required to reach LFL due to hydrogen accumulation for each waste tank and pump tank in Tank Farms [3].

10.3 Prevent Formation of Shock Sensitive Compounds

No waste containing silver shall be transferred into the Tank Farms.

Note: this specification does not prohibit silver present as a fission product, or a minimal quantity of silver present as a result of laboratory and/or analytical methods, or if the quantity received is evaluated to have no impact on the TF.

Basis

This requirement is based on administrative controls resulting from previous transfers of silver-laden flush water from the F/H-Canyons. In 1970, popping noises were heard when dried waste deposits in the Tank 21 feed-jet enclosure and the 242-H Evaporator cell were disturbed by personnel and/or equipment. Investigation of the incident revealed that silver was present in the waste feeding the evaporator, and likely formed silver nitride, a shock sensitive compound [19]. The silver was present due to flushes of the silver coated Berl saddles used in the canyons to remove radioiodine. After an administrative control prohibiting such flushes was implemented in the Canyons, no similar incidents have been observed.

10.4 Requirements for Radionuclide Content for Waste Receipts

Calculations of IDP for influent streams to the TF should use the following dose conversion factors in their calculations [49]. Because Ba-137m has a half-life of 2.55 minutes, it does not have a IDCF; however, the Cs-137 IDCF does include the dose from Ba-137m that is formed in the body after intake.

Table 2: Tank Farm Inhalation Dose Conversion Factors

Radionuclide	Inhalation Dose Conversion Factor (rem/Ci)
Sr-90	5.9E+05
Y-90	5.6E+03
Cs-137	1.9E+04
Ba-137m	0.0E+00
Pu-238	1.7E+08
Pu-239	1.9E+08
Pu-240	1.9E+08
Pu-241	3.3E+06
Am-241	1.6E+08
Cm-244	1.0E+08

All sample results reported to demonstrate compliance with the requirements for IDP must include the analytical uncertainty of 2 sigma and the uncertainty must be used in any subsequent calculations based on those results [36].

10.4.1 Receipt Inhalation Dose Potential Criteria for Slurried Type IV Waste Tanks [*A/C* SAC 5.8.2.15]

Transfers into slurried Type IV tanks may not cause the tank waste limit for the material at risk of 1.0E+07 rem/gallon for any slurried Type IV waste tank to be exceeded [3.

The total IDP in a slurried Type IV waste tank shall be less than or equal to 1.0E+07 rem/gallon [3]. The IDP limit for transfers into Type IV waste tanks is imposed on the waste tank, rather than the influent waste stream. Generators sending waste to Type IV waste tanks shall provide data on a per transfer basis that will allow for the determination of the resulting IDP in the Type IV receipt tank (See Section 8). A total allowance of sludge will be determined for any Type IV waste tank designated for receipt from a waste generator. The total allowance of sludge will protect the total bounding IDP rate of 1.0E+07 rem/gallon (at a controlled minimum volume for the receipt tank). For a generator to send waste to a Type IV waste tank, they must demonstrate through their WCP a method for staying within that total sludge allowance and tracking the total sent. Flowsheet changes (e.g., change of sludge batch) will drive changes to the total sludge allowance.

Basis

The 1.0E+07 rem/gallon requirement is from the CSTF DSA and TSR. Type IV waste tanks are assumed to contain material at risk which has a slurry dose potential bounded by 1.0E+07 rem_{inh}/gallon [3].

For the purpose of inhalation dose potential total in Type IV waste tanks, it is assumed that there is no mixing available and thus sludge transferred into the tank will accumulate. The total sludge amount transferred into Type IV tanks must be accounted for.

10.4.2 Receipt Inhalation Dose Potential Criteria for non-Type IV Waste Tanks [*A/C* SAC 5.8.2.15, SAC 5.8.2.21, SAC 5.8.2.25]

The waste stream composite (solids and liquids) IDP concentration must be less than 1.5E+09 rem/gallon to be received in the Tank Farms [3]. This limit is imposed on the influent waste stream. In addition, waste transfers may be categorized as "High-Rem" or "Low-Rem" transfers. High-Rem waste transfers have an IDP of greater than 2.0E+08 rem/gallon, while Low-Rem transfers have an IDP of less than, or equal to, 2.0E+08 rem/gal [3]. It is assumed in the DSA that all Canyon transfers are Low-Rem, and thus, must remain as such. Low-Rem transfers that exceed 1.0E+08 Rem/gal require, within 30 days, a sufficient flush of the core pipe such that the inhalation dose potential of the residual waste in the core pipe is less than or equal to 1.0E+08 rem/gal. If an evaluation indicates that the IDP of the residual waste in the core pipe is less than or equal to 1.0E+08 rem/gal, flushing is not required. If flushing is required, the necessary flush volume and duration shall be determined. Flushing is not required if the time between transfers is less than 30 days (the 30-day completion time for the flush shall be based on completion of the last transfer) [3]. Any transfer which has an IDP above 9.8E+07 Rem/gallon shall be considered a sludge-slurry transfer and shall be labeled as such in the generators' WCP. Sludge-slurry transfers require special flushing procedures in order to be transferred to the Tank Farms. In addition, all generators must identify in their WCP's whether a given waste stream is considered to be a High-Rem or Low-Rem transfer. In order to make a High-Rem transfer, generators must submit a special WCP.

Material transferred into the 2H evaporator feed tank (i.e., Tanks 43H) shall not cause the evaporator bottom IDP of 3.3E+07 rem/gallon to be exceeded [3]. **[*A/C* SAC 5.8.2.25]**

Material transferred into Tank 50 (SPF feed) shall not have an inhalation dose potential greater than 1.79E+05 rem/gal [3]. **[*A/C* SAC 5.8.2.15]**

Basis

These requirements are mitigative measures to ensure that the consequences of explosion events are bounded by the current DSA accident analysis and to ensure no additional safety basis controls are necessary [3].

Accident analyses of liquid waste with an IDP above 1.5E+09 Rem_{inh}/gallon have not been performed; therefore, acceptance of a liquid waste above IDP limit would require a USQ to be completed and could require an SB change.

The waste material in Tank 50, Tank 50 Valve Box, and the receipt transfer lines in the SPF WAC [6] has an IDP limit of 1.79E+05 rem/gal. To ensure feed to SPF meets this limit, influent streams to Tank 50 should also meet this limit, accounting for analytical uncertainty of 2 sigma.

10.5 Requirements for Regulatory Compliance

An Environmental Evaluation Checklist (EEC) shall be generated for each new waste stream received in the facility. Completion of the EEC is the responsibility of the organization or facility that is the source of the new waste stream received into the facility.

Permit modifications may be necessary for process changes within the scope of this WAC. The ECA is responsible for determining if proposed changes require permit modifications.

No Resource Conservation and Recovery Act (RCRA) hazardous "listed" waste will be received in the Tank Farms.

Except for the following, waste received in the Tank Farms must be below the RCRA Toxicity Characteristic Leaching Procedure (TCLP) toxic "characteristic" concentration limits [20]. The "Mixed Waste Site Treatment Plan" [21] lists the species that are allowed to exceed the TCLP criteria:

Characteristic	TCLP Code [20]
Corrosivity	D002
Ba	D005
Cr	D007
Pb	D008
Hg	D009
Ag	D011 (except refer to Section 10.3 limitation)
Benzene	D018

Basis

The Tank Farms are permitted for operation as an Industrial Wastewater Treatment Facility [22]. Waste stream composition must be controlled to ensure that the applicable Tank Farm permits are met. Similarly, waste composition must be controlled to ensure that permits of downstream processing facilities and site-level permits are not affected, including the generation of secondary waste from activities within the Tank Farm.

A prohibition on RCRA "listed" wastes [20] is imposed to ensure that any waste received into the Tank Farms can be processed by DWPF, Saltstone and the ETP; and that solid wastes generated from LWF operations can be properly disposed of in the SWDF. All waste will eventually be processed through these facilities, and the respective regulatory permits require final waste forms be non-hazardous (e.g., high-level waste glass, Saltstone, and ETP's treated effluent). The Environmental Protection Agency (EPA) and South Carolina Department of Health and Environmental Control (SCDHEC) regulations specify that anything "derived from" (e.g., mixed with) a "listed" hazardous waste are also considered "listed" hazardous wastes (unless the difficult process of "de-listing" is accomplished). Thus "listed" wastes are excluded from the Tank Farms to prevent creating hazardous products in DWPF, SWPF, Saltstone, and ETP. There are some exemptions whereby the use of chemicals on the RCRA lists does not cause the waste to be "listed". If the waste generator uses such chemicals, then the WCP must include the Environmental Services Section's written concurrence that the specific use does not cause the waste to be "listed". For example, if particular chemical were used in the production process, then that waste would be "listed". However, if that same chemical is used in a laboratory analysis and the lab waste meets certain other requirements, then the lab waste stream would not be "listed".

The "Mixed Waste Site Treatment Plan" [21] lists the RCRA constituents that are currently found in the Tank Farms at concentrations greater than the TCLP limits. New constituents could be added to the plan (and then to the "acceptable" list in this WAC) if the new constituents are shown to be compatible with the treatment plan and applicable industrial wastewater permits.

10.6 Requirements for Criticality Safety

[*A/C* SAC 5.8.2.15 and DSA 6.5.2]

All sample results reported to demonstrate compliance with the requirements for criticality safety must include analytical uncertainty of 2 sigma, and the uncertainty must be used in any subsequent calculations based on those results [3].

Waste received in the Tank Farms shall be subcritical for any concentration and mass in the uncontrolled geometry of the waste tanks. Table 3 provides the required weight ratio of a single neutron poison to equivalent U-235 and Pu-239 to ensure the waste is inherently safe. To determine the equivalent U-235 for sludge slurries (applicable for all poisons), use the appropriate equivalency factor (EF) from Table 2 (i.e. Equivalent U-235 = U-235 + EF (Pu-239+Pu-241)) [23, 24]. For waste transfers that contain U-233, the U-233 should be considered Pu-239.

If multiple neutron poisons are present in the waste stream, additional safe weight ratios for multiple neutron poisons can be evaluated for use. Alternatively, Equations 4-7 show the single and multiple weight ratios for neutron poisons to U-235 and Pu-239 for mixed fissile waste streams. Equations 1-4 do not use equivalency factors of any kind (i.e., single fissile isotopes are used). Equations 4-7 only apply to Canyon transfers and shall not be applied to poisoned DWPF, or SWPF waste streams.

Table 3: Safe Weight Ratios for Neutron Poisons to Equivalent U-235 and Pu-239

Single Neutron Poison	Required Weight Ratio to Equivalent U-235	Required Weight Ratio to Equivalent Pu-239	Equivalency Factor Pu-239 to U-235	Reference
Fe	72	160	2.25	[23]
Mn	14	29	2.07	[23]

<u>Single and Multiple Safe Weight Ratios for Neutron Poisons to Equivalent U-235</u>

For Fe Addition:
Equation 4: [Fe: U-235] = (-5.8* [Mn: U-235]) + 70 - [known Fe: U-235] [23]

For Mn Addition:
Equation 5: [Mn: U-235] = (-0.17* [Fe: U-235]) + 12 - [known Mn: U-235] [23]

<u>Single and Multiple Safe Weight Ratios for Neutron Poisons to Equivalent Pu-239</u>

For Fe Addition:
Equation 6: [Fe: Pu-239] = (-5.7* [Mn: Pu-239]) + 160 - [known Fe: Pu-239] [23]

For Mn Addition:
Equation 7: [Mn: Pu-239] = (-0.17* [Fe: Pu-239]) + 28 - [known Mn: Pu-239] [23]

Notes

1. Under certain circumstances when a waste stream can be demonstrated to only contain <15 g of fissile material a deviation to adding neutron poisons may be possible [26].
2. An equivalency factor of 2.25 or 2.07 should be applied to (Pu-239 + Pu-241) to determine the equivalent U-235 mass when poisoning with Fe and Mn, respectively [23, 43]. Equivalency factors shall not be used in Equations 4-7. (The 1.6 equivalency factor is taken from Reference 43 which states 0.65 grams of Pu-239 is equivalent to 1 gram of U-235, by inverting that ratio one arrives at 1.53. Using a 1.6 ratio is therefore conservative.)
3. The generator's WCP document shall demonstrate that criticality is not a concern. If the fresh waste is a slurry, then the settled sludge phase (i.e., the concentrated insoluble phase) must also be demonstrated to be safe.
4. TFE will evaluate the waste stream characterization for downstream processing impacts (e.g., aluminum dissolution in Extended Sludge Processing (ESP), concentrated supernate and salt cake produced by evaporation).
5. The solubility of fissile material and neutron poisons is low in supernate due to the alkaline chemistry maintained in the waste tanks. The fissionable material along with the chemical compounds tends to settle to the bottom of the waste tank to form a sludge layer. Therefore, supernate is critically safe in the uncontrolled geometry of the waste tanks and there is no requirement to report the weight ratios of neutron poisons to equivalent U-235.
6. H-Canyon limits the routine waste transfers to contain less than a fissile mass unit (U-235 eq. ≤ 624 grams, Pu-239 eq. ≤ 390 grams) per batch or less [27]. A special or regular WCP must be submitted and approved to transfer more than a fissile mass unit per batch.

Gadolinium is acceptable as a neutron poison [3] at a mass ratio for Gd: Pu-239 equivalent that is 1:1 or greater with Hydrogen to Plutonium ratios greater than 30:1[29]. Use of Gd as a poison must be evaluated prior to acceptance of the waste stream to confirm the multiple safe weight ratios of neutron poisons to fissile is maintained in the receipt tank.

Basis

The waste tank sludge inventory at SRS has a low fissile material concentration, low areal density of fissile material, and an abundance of neutron absorbing diluents in the sludge matrix. Each of these three properties contributes to demonstrating that sludge is subcritical for any concentration and mass in the uncontrolled geometry of the waste tanks. The fissile material is distributed in a large volume, over a large surface and co-exists with other waste materials that are effective neutron absorbers. To describe the criticality safety margin associated with the SRS sludge inventory, the use of safety parameters is required. Because sludge is a variable mixture of insoluble solids with varying elemental compositions, calculating safe fissile material concentrations for specific sludges is tedious. Because of the low fissile material concentrations, the neutron absorber to fissile material ratios are high resulting in sludge being an inherently safe mixture. The criticality safety margin demonstrated in the waste tank's low areal densities is supplemented by an abundance of neutron absorbers. Three consistently abundant neutron-absorbing elements, for which safe weight ratios to (Pu-239 + Pu-241) and U-235 have been calculated, are iron, chromium, and manganese. In addition to the iron, chromium, and manganese, safe ratios of (Pu-239 + Pu-241) have been determined if the U-235 content of the uranium is at or below that found in 0.96 wt. % uranium. This latter safety parameter is very useful in describing criticality safety in waste tanks that received large amounts of depleted uranium, like that found in PUREX waste. Demonstrating criticality safety based solely on the presence of one or two sludge diluents, while neglecting the presence of other neutron absorbing diluents indicates a large margin of safety. This margin of safety is demonstrated independently of the physical distribution of the fissile material in the waste tanks.

TFE's evaluation (refer to Section 5) will utilize data for several of the species included in the waste stream characterization (refer to Section 6.2).

10.6.1 Uranium Enrichment in 2H Evaporator System (includes Tanks 38 and 43)

External transfers that may be sent directly into Tanks 43, 38, or 22 must meet the following conditions:

- ≤ 5.5 wt% U-235 (eq) enrichment (DWPF must re-evaluate enrichment upon changing sludge batches) [34,30]
- U-235 eq is to be calculated per the formula:
  U-235 (eq) = U-235 +1.4 * U-233 + 2.25 * (Pu-239 + Pu-241)
  U (eq) = U + 2.25 * (Pu-239 + Pu-241)
- The plutonium content of the fissionable elements in the waste transfers into the 2H Evaporator System shall not exceed 2wt%. [30]

Basis

Prior to acceptance of a new sludge batch, DWPF must confirm that a U-235 (eq) enrichment of 5.5 wt% is not exceeded. DWPF satisfies this requirement by requiring that the sludge fed from the Tank Farm to DWPF have an enrichment of ≤5.5 wt% U-235 (eq). The limit on plutonium content in the supernate in the 2H evaporator system is an administrative control required by the 2H NCSE. Prior to acceptance of a new sludge batch, DWPF must confirm that the plutonium content of the fissionable elements in the waste transfers into the 2H Evaporator System shall not exceed 2 wt%.

10.7 Requirements to Protect Heat Generation Rate

[*A/C* SAC 5.8.2.15]

The CSTF DSA requires that the waste tanks in the facility contain waste with a heat generation rate less than 8.0E+05 BTU/hr, and the pump tanks in the facility contain waste with less than 2.1E+04 BTU/hr. This requirement has been determined to be bounding for all incoming waste streams, so no additional controls are necessary.

Basis

The basis for the heat generation rates listed in the DSA and historical information shows that these limits are bounding and need no further controls [31].

10.8 Requirements to Satisfy Downstream Facility Acceptance Criteria

[*A/C* SAC 5.8.2.15]

Waste received in the Tank Farms shall be characterized sufficiently for TFE to demonstrate that the Tank Farm's ability to meet various acceptance criteria imposed by the downstream processing and disposal facilities will not be impaired.

For waste being transferred to Tank 50, the SPF WAC [6] describes the criteria required for the transfer of low-level aqueous waste from Tank 50H to the SPF. Reference 45 provides the minimum constituents that must be characterized in order to demonstrate compliance with the SPF WAC. Those constituents are listed in Table 4 below. Sample results or process knowledge may be used to determine the concentration of these constituents contained in a waste stream, but a value for all of the constituents must be given. This information is used to demonstrate continual compliance with the SPF requirements. Additional sample analyses may be required by the TF if such samples are deemed necessary to ensure the accuracy of the Tank 50 characterization. In addition, the waste generator must ensure that no waste that is hazardous or that will produce solid saltstone classified as Transuranic (TRU) or High Level Waste (HLW) is transferred to Tank 50.

Table 4 – Required Analytes for SPF Characterization

Chemical Analyte	Radionuclide
Al	Sr-90/Y-90 (Total and Soluble)
OH	Cs-137/Ba-137m
Hg	U-233
K	U-234
Si	U-235
SO_4	U-236
NO_2	U-238
NO_3	Pu-238
TIC	Pu-239
TOC	Pu-240
Na	Pu-242
CO_3	Pu-244
PO_4*	Total Alpha
Cl	Total Beta
F	Total Gamma
Formate*	
Oxalate	
Insoluble Solids Wt %	
Density	

*Constituents not required by Ref. 45, but required for SPF WAC compliance

The constituents listed in Table 3 should be characterized (by sample analysis or process knowledge) by the generators to demonstrate compliance with the SPF requirements for IDP, Flammability (Hg and Isopar-L), Hydrogen Generation Rate, Nuclear Criticality, Chemical Limits, Radiological Limits, General Processing Criteria, Gamma Shielding, and Chemical Resistance of Saltstone Disposal Unit Liner/Coating. Reference 45 provides the methodology for demonstrating compliance with these requirements using the reduced listing of analytes in Table 3.

In addition, generators to Tank 50 must demonstrate compliance with the SPF WAC Temperature limit and SWPF must demonstrate compliance with the SWPF Processing Requirements.

Prior to transferring waste into Tank 50, a waste generator must demonstrate compliance with the SPF WAC Limits. If a waste generator is unable to meet an SPF WAC Limit, on any constituent(s), a deviation request will be made. The approval/disapproval of the deviation request by the Tank Farm will determine whether the waste stream will be approved to be transferred to Tank 50.

Due to an undesirable effect on Caustic Side Solvent Extraction processing, the anti-caking agent, Petro AG shall be excluded from DWPF recycle.

For waste streams that will be received into one of the Tank Farms evaporator systems, the following constituents must be analyzed and compared to the ETP WAC [9] to avoid any detrimental downstream impacts on ETP: Tritium, ammonia, mercury and beta-gamma. Stream composition can be compared against historical feed compositions to show compliance. Impacts will be documented in the WCP.

Note: The SPF WAC, X-SD-Z-00004, Revision 1 [6] is the approved version at the time of implementation of this TF WAC, Revision 2.

Note: TFE will evaluate the waste stream characterization to ensure that any impacts on downstream facilities are recognized, evaluated and approved.

Basis

All waste sent to the Tank Farms eventually goes to "downstream" treatment and disposal facilities. Waste sent to the Tank Farms must be compatible with various acceptance criteria imposed by those facilities. Each individual transfer or waste stream sent to the Tank Farms does not need to meet each of the downstream acceptance criteria (except for influents to Tank 50 – see paragraph below), but a given stream must not prevent the Tank Farm from meeting those criteria:

- DWPF, SPF [5, 6], and ETP's requirements (e.g., H-3) [9]
- SWDF's Waste Acceptance Criteria (e.g., solid low level waste characterization, B-25 tornado accident) [39],
- Tank Farm Evaporators (e.g., evaporator IDP 3.3E+07 Rem/gallon for 2H),
- Tank Farm Waste Tanks and pump tanks heat generation,
- Single Contained transfer lines (< 0.05 Ci/gal), and
- Tank Farm Vamp detection during "High-Rem" transfers (e.g., IDP limits, area radiation monitors spill detection (i.e., 1 Ci/gal Cs-137))

A material balance is being kept for constituents going into Tank 50 (i.e. WCS Online). The constituents needed to maintain this material balance are given in the SPF WAC [6]. All influent streams into Tank 50 must either meet the SPF WAC LIMITS [6] directly, or a deviation request must be made. The approval of the deviation request from the SPF WAC LIMITS shall be required prior to the approval of the waste generator's WCP to Tank 50. Saltstone WAC TARGETS may be exceeded by an influent to Tank 50 given the downstream impact analysis evaluates the stream as ultimately acceptable.

10.9 Industrial Hygiene Safety

Personnel protection issues shall be discussed in the WCP. Additional Health and Safety Information shall be provided for all new chemicals contained in radioactive solutions which are introduced into the facility. In the DSA, the Chemical Inventory Program provides control over new chemicals entering the facility. Safety Data Sheets are governed at a site level program.

Basis

Liquid waste received into the Tank Farms could expose Tank Farm personnel to chemical hazards at concentrations above the Occupation Safety and Health Administration (OSHA) limits. Chemical constituents that present a hazard should be identified, and the OSHA permissible exposure limits stated.

Consideration on the chemical constituent behavior under the Tank Farms conditions should be addressed. For example, ammonium has a low vapor pressure in acidic solutions; however, under the alkaline tank farms conditions the ammonium is converted to ammonia and is evolved into the vapor space of waste tanks and pump tanks. Venting ammonia could expose personnel to concentrations above OSHA limits, depending on the individual facilities ventilation system and atmospheric conditions.

10.10 Tanker Trailer Waste Receipt Criteria

The following requirements must be met for tanker trailer waste receipts into the Tank Farms.

1. identification number of each tanker
2. volume of material in each tanker
3. any material heel shall be evaluated for potential impacts to subsequent deliveries
4. comply with requirements of 5Q 1.1 [48] for radiation and contamination control
5. completion of Transfer Report Form (if needed) as agreed to in the WCP
6. inhalation dose potential must be provided to TFE (in WCP) for review

10.11 Transfer Requirements of Radioactive Waste into the Tank Farms [*A/C* SAC 5.8.2.15 & DSA 5.7.1]

The following interface control requirements require TSR controls within the appropriate waste sender's Safety Basis to protect the CSTF safety analysis assumptions [3]. The following requirements are not part of the 5.8.2.15 SAC unless specifically noted.

1. Notification shall be provided to (and concurrence received from) the CSTF Shift Manager/First Line Manager/Control Room Manager prior to intended transfers to the CSTF.
2. The equipment needed to stop transfers, siphons, and liquid additions to the CSTF shall be available to respond to indications of a primary containment waste release. This requirement is a SAC.
3. When transferring material to the CSTF with an inhalation dose potential greater than 2.0E+08 rem/gal , the following shall be required:
   a. For facilities that own the leak detection capability of a CSTF owned transfer line (e.g., H-Canyon transfers to the CSTF), leak detection with control room alarm shall be operable within the Leak Detection Boxes associated with the Transfer Path. This requirement is a SAC.
   b. Two physically separated functional transfer isolation devices shall be identified. The transfer isolation devices shall be sufficiently separated (by distance) such that the availability of one isolation device is maintained.
4. Transfers into the CSTF shall be secured as a result of a tornado warning, tornado watch, or high wind warning for the CSTF as issued by the SRS Operations Center. This requirement is a SAC.
5. Transfers into the CSTF shall be secured following a seismic event. This requirement is a SAC.
6. Transfers into the CSTF shall be secured following notification of a CSTF wildland fire event. This requirement is a SAC.
7. Transfers into the CSTF shall be secured following notification of a CSTF control room abandonment event. This requirement is a SAC.
8. For evolutions not intended for the CSTF, sound isolation (single leak-tested valve, double valve isolation, blank, or jumper removal) shall be required. Where sound isolation is not possible, notification shall be given to (and concurrence received from) the CSTF Shift Manager/First Line Manager/Control Room Manager of the potential for an unintended transfer prior to the intended transfer.
9. Notification shall be given to (and concurrence received from) the CSTF Shift Manager/First Line Manager/Control Room Manager prior to performing excavations potentially affecting CSTF transfer lines.

11.12 Transfer Requirements to 299-H

[*A/C *SAC 5.8.2.42]

299-H Tank Farm Maintenance Facility is a part of the CSTF Facilities. 299-H is a Hazard Category 3 facility. To preserve that designation, compliance with the 299-H Inventory Control Program, WSRC-TR-97-0342 [37], is required. All materials processed in the 299-H Facility shall be characterized sufficiently for TFE to demonstrate that the Tank Farm's ability to meet various acceptance criteria imposed by the downstream processing and disposal facilities will not be impaired.

Components from facilities other than the Tank Farms will require Special WCP to show acceptability for receipt into the 299-H facility.

11 Records

Records and documentation generated as a result of the WAC and WCP will be maintained by TFE and by the individual Waste Generators (per their Division's Record Retention Schedule "RIDS").

12 References

1 S-TSR-G-00001, Concentration, Storage, and Transfer Facilities Technical Safety Requirements

2 WSRC-IM-94-10, LWD/WS Project Safety Basis Manual

3 WSRC-SA-2002-00007, Concentration, Storage, and Transfer Facilities Documented Safety Analysis, including HLW-CRF-18002

4 WSRC-TR-2002-00327, CSTF Corrosion Control Program

5 WSRC-SA-6, S-Area DWPF Safety Analysis Report

6 X-SD-Z-00004, Rev 1, Waste Acceptance Criteria for Aqueous Waste Sent to the Z-Area Saltstone Production Facility (U). December 2018.

7 X-SD-S-00001, Rev. 1, Waste Acceptance Criteria for Raw Salt Solution, Sludge and SWPF Salt Streams Transfers to DWPF (U)

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9 X-SD-H-00009, F/H Effluent Treatment Project Waste Acceptance Criteria

10 WSRC-TR-93-00056, Solubility of Plutonium and Uranium in Alkaline Solutions, D.T. Hobbs, February 12, 1993

11 WSRC-TR-2003-00336, Inhibitor Limits for Recycle Waste Generated by the DWPF (U), P. E. Zapp, February 2004

12 WSRC-TR-94-072, P. E. Zapp, Inhibitor Levels for the DWPF Recycle Stream (U), February 8, 1994

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14 DP-1347, R. S. Ondrejcin, Chemical Compositions of Supernates Stored in SRP High Level Waste Tanks, August 1974

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21 WSRC-TR-94-0608, SRS – Mixed Waste – Proposed Site Treatment Plan, March 1995

22 J. W. Chapman (for SCDHEC), Project: F and H Area High Level Radioactive Waste Tank Farms Construction Permit No.: 17,424-IW, County Aiken and Barnwell, March 3, 1993

23 N-NCS-H-00152, Nuclear Criticality Safety Evaluation: H-Canyon Waste Stream Poisoning with Fe and Mn, M. D. Murray

24 WSMS-CRT-02-0087, Standardization of Uranium Equivalency Factors for High Level Waste (HLW), M. C. Murray

25 WSRC-TR-93-0872, Canyon Transfer Neutron Absorber to Fissile Material Ratio Analysis (U), Revision 1, J. S. Clemmons, March 4, 1994

26 WSRC-SCD-3, WSRC Criticality Safety Manual

27 N-NCS-H-00037, H-Canyon Double Contingency Analysis, Latest Revision

28 Reference Deleted

29 N-NCS-H-00134, Rev. 4, Nuclear Criticality Safety Evaluation: Minimum Safe Gadolinium to Plutonium Ratio in an Infinite System

30 N-NCS-H-00180, Rev. 1, Nuclear Criticality Safety Evaluation: Operation of the 2H Evaporator, D. A. Eghbali, August 2008.

31 WSRC-TR-2003-00515, Position Paper: Heat Generation Rate and Its Implications on the Tank Farm WAC, P.B. Rogerson, December 2003.

32 Reference Deleted

33 S-CLC-Z-00080, Rev 0, Maximum Permissible Fill Level to Remain Within CLFL in Vault 2

34 WSRC-TR-2003-00055, CSTF Evaporator Feed Qualification Program

35 Reference Deleted

36 WSRC-TR-2003-00524, Position Paper: Laboratory Sample Uncertainties and Their Impact on the Tank Farm WAC (U), P. B. Rogerson, January 2004

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38 WSRC-TR-2003-00048, Rev. 4, Waste Characterization System Program Description Document

39 1S Manual, SRS Waste Acceptance Criteria

40 U-ESS-G-00007, Rev. 0, Evaluation of the Safety of the Situation (ESS): Potentially Inadequate Recognition of the Effect of Organics on Hydrogen Generation Rates in the Concentration, Storage, and Transfer Facilities (PISA-PI-2017-00003), July 2017.

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45 X-ESR-H-00907, Rev. 1, Compliance Evaluation of Salt Batch Characterization Efforts to Support SWPF Processing, J. J. Jordan, August 2018

46 N-ESR-G-00001, latest revision, High Level Waste Emergency Response Data and Waste Tank Data

47 E7, 2.31A, latest revision, Conduct of Engineering – LW Engineering Calculations

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