DEC 2 0 2002

Mr. Robert A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) for the 10CFR830 Compliant Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR's)

References:

1. Letter, Piccolo to Anderson, "Resubmittal of Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements for DOE Approval," HLW-2002-00154, 11/15/2002
2. Letter, Piccolo to Anderson, "Submittal of Changes to the Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements with DOE for Approval," HLW-2002-00164, 12/11/2002
3. Letter, Anderson to Piccolo, "Submittal of Concentration, Storage, and Transfer Facilities (CSTF) Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR's) for DOE Approval," PC-02-058, 8/16/2002
4. Letter, Anderson to Piccolo, "Submittal of Concentration, Storage, and Transfer Facilities (CSTF) Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR's) for DOE Approval," PD-02-025, 9/24/2002
5. Letter, Piccolo to Anderson, "Submittal of Concentration, Storage, and Transfer Facilities Documented Safety Analysis Implementation Plan," HLW-2002-00101, 7/19/2002

The Department of Energy (DOE) - Savannah River Operations Office (SR) evaluated the CSTF DSA and TSR's developed per 10CFR830 and concluded the safety basis documents were compliant with the safe harbors specified in 10CFR830, Subpart B, Appendix A. The safety basis documents submitted in Reference 1 and amended in Reference 2 adequately addressed the DOE comments in References 3 and 4, except for the waste tank annulus conductivity probes. To address this remaining issue, a Condition of Approval is identified in the enclosed SER. Thus, assuming adequate incorporation of this Condition of Approval, these safety basis documents are approved and the enclosed SER provides the basis for this approval.

DOE recognizes that the recent issue (NI-HLW-02-003) involving oxalate solids in 50H could have impacts on the DSA and TSR's submitted in References 1 and 2 (e.g., flammable gas accumulation, criticality, explosive compounds, etc.). These potential impacts on all applicable CSTF locations are expected to be addressed in resolving Potential Inadequacy in the Safety Analysis NI-HLW-02-003. This expectation has been discussed with your staff. Once all of the actions necessary to implement these safety basis documents are completed as described in Reference 5, you are requested to submit to me for approval a revision to the CSTF Authorization Agreement (WSRC-RP-2001-00154) prior to making these safety basis documents effective. As discussed in Reference 5, implementation of these safety basis documents is scheduled for February 28, 2003. These actions have been discussed with your staff.

Finally, you are requested to develop and implement a plan by April 2003, to ensure the planned equipment improvements identified in Table 3.3-16 of the DSA are performed within the life cycle of the CSTF. It is expected that this plan will include prioritization of these modifications.

Please take action to ensure that the budget cycles (Fiscal Year 2005 and beyond) include the funding requests to support this prioritization. These actions have been discussed with your staff.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or Michael Mikolanis at 208-6328.

Sincerely,

Original Signed By
Jeffrey M. Allison

Jeffrey M. Allison
Acting Manager

ED:TCT:kl

PC-03-008

Enclosure:
CSTF SER Rev. 0

cc w/encl: J. Dewes, WSRC, 703H

cc w/o encl: V. G. Dickert, WSRC, 703H
W. C. Clark, WSRC, 241-100F
D. B. Little, WSRC, 703H
S. A. Thomas, WSRC, 703-H
W. T.Davis, WSRC, 707-H

bcc w/encl: S. M. Aleman, ED
T. C. Temple, ED
D. J. Blake, ED
J. A. Smartt, EAD, 730-B
D. Stadler, EH-2, HQ

bcc w/o encl: AMHLW Rdg File
Mngr's Rdg File
ECAT, 703A, 022306, 021968, 022477
ED Rdg File
IMS

SAFETY EVALUATION REPORT
REVISION 0

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES
OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS, WSRC-SA-2002-00007, REV. 0
CSTF TECHNICAL SAFETY REQUIREMENTS, S-TSR-G-00001, REV. 0

December 2002

Prepared by: Larry A. Hinson
Larry A. Hinson, Team Leader

Reviewed by: Sue Aleman
Sue M. Aleman

Approved by:
Micheal A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR HIGH LEVEL WASTE
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

Executive Summary

This Safety Evaluation Report (SER) documents the basis for the U.S. Department of Energy (DOE) approval of the Concentration, Storage, and Transfer Facilities (CSTF) Documented Safety Analysis (DSA, WSRC-SA-2002-00007, Revision 0) and associated CSTF Technical Safety Requirements (TSRs, S-TSR-G-00001, Revision 0). The purpose of the CSTF DSA is to describe the design and safety analysis of the facility in sufficient detail to demonstrate the facility has been constructed and can be operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. The DSA also derives and defines the conditions, safe boundaries, and the management and administrative controls necessary to ensure the safe operation of the CSTF. The CSTF DSA and TSRs were prepared by Westinghouse Savannah River Company (WSRC), the primary contractor for management and operation of the Savannah River Site (SRS) located near Aiken, South Carolina.

The CSTF are part of the overall High Level Waste Facilities. The CSTF are a group of facilities and support services designed to receive, store, process and safely manage radioactive wastes from production and research facilities at SRS. The CSTF include the F-Tank Farm (FTF) and the H-Tank Farm (HTF).

The F-Tank Farm facility includes waste storage tanks, pump tanks, the 242-F (1F) and 242-16F (2F) evaporators, and numerous associated transfer structures/components (e.g., diversion boxes) located in F-Tank Farm, as well as the F/H Inter-Area Transfer Line. The HTF facility consists of waste storage tanks, the 242-H (1H), 242-16H (2H) and 242-25H (3H) evaporators, the Filter/Stripper Building (241-96H), the 299-H Maintenance Facility, pump tanks, and numerous associated transfer structures/components.

The CSTF perform these primary functions within the radioactive waste management program at SRS: receipt, concentration through evaporation, storage, removal and transfer of liquid high level waste, and sludge washing as pretreatment to support Defense Waste Processing Facility (DWPF) operations. To accomplish these functions, transfer capability exists within the CSTF, as well as between the CSTF and the DWPF, the F- and H-Canyon Facilities, the Receiving Basin for Off-Site Fuel, Saltstone, and the Effluent Treatment Facility.

The CSTF DSA/TSRs evaluated and described in this SER constitute the principle 10 CFR 830 compliant safety basis documents for the F-Tank Farm facilities and the H-Tank Farm facilities described above. The CSTF DSA sets forth the deterministic accident analyses; describes design basis accident scenarios considered and analyzed; projects radiological and non-radiological consequences to the offsite public and onsite workers; compares the projected consequences against EGs; and derives the necessary safety class and safety significant features and controls to ensure the design basis accidents are within the applicable EGs. Major facility hazards involve deflagrations in various tanks/vessels, surface spills of liquid waste and aerosolization events. Based on the radioactive material inventory of the facility and projected worst case accident consequences, the CSTF is classified as a Hazard Category 2 nuclear facility in accordance with the guidelines of DOE-STD-1027-92.

The CSTF TSRs set forth the operating limits, surveillance requirements, and administrative controls which are used by facility operators to ensure the CSTF structures, systems, and components are kept within safe performance boundaries. The CSTF TSRs contain use and application instructions, and provide the bases for the limits, requirements, and controls.

As a result of the DOE review, DOE identified one Condition of Approval, which will necessitate revision to the DSA and TSR concerning the waste tank annulus conductivity probes for leak detection. With the adequate incorporation of this Condition of Approval, DOE approves these documents as the CSTF DSA nd TSR. The basis for DOE approval is the determination that: the accident analysis is complete and comprehensive; the derived set of controls are commensurate with the hazards; the design of structures, systems, and components reflects that diversity and defense-in-depth concepts are in place where appropriate; and all other major programmatic elements covered in the DSA are adequate to support safe operation of the CSTF. In addition, DOE review of the TSRs concluded that the parameters requiring operating limits, surveillance requirements, and administrative controls have been properly identified and developed, the use and application instructions are appropriate and clear, and the bases contain the proper linkage to the accident analysis documented in the DSA.

Revision Log

Revision	Purpose	Date
0	Initial issuance documenting results of DOE review of 10 CFR 830 CSTF DSA and TSRs	12/2002

Table of Contents

	Page
Executive Summary	1
Revision Log	3
Table of Contents	4
I. Background and Review Process	5
A. Introduction	5
B. Facility Description	5
C. Document Content and Conclusions	5
D. DOE Review Criteria	6
E. DOE Review Chronology and Methodology	7
F. DOE Conditions of Approval	8
G. Summary of DOE Evaluation	8
H. References	9
II. DSA Approval Bases	10
A. Base Information (DSA Chapters ES, 1, and 2)	10
B. Hazard and Accident Analysis (DSA Chapter 3)	11
C. Safety Systems, Structures, Components (DSA Chapter 4)	63
D. Derivation of Technical Safety Requirements (DSA Chapter 5)	83
E. Programmatic Control (DSA Chapters 6 through 17)	94
F. Tank 48 (DSA Chapter 18 and Related TSRs)	101
III. TSR Approval Bases	110
Appendix A – CSTF DSA/TSR DOE Review Team for SER Revision 0	116
Appendix B – Draft DSA/TSR Changes to Address Condition of Approval	117

I. Background and Review Process

A. Introduction

This SER documents the basis for DOE approval of : (1) the CSTF Documented Safety Analysis (DSA), WSRC-SA-2002-00007, Revision 0, November 2002, and (2) the CSTF TSRs, S-TSR-G-00001, Revision 0, November 2002. The CSTF DSA, WSRC-SA-2002-00007, Revision 0 was submitted to DOE by WSRC for approval by letter dated November 15, 2002, (Reference 1) with addendum changes submitted by letter dated December 11, 2002 (Reference 16). The purpose of the CSTF DSA is to describe the design and safety analysis of the facility in sufficient detail to demonstrate the facility has been constructed and can be operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. The DSA also derives and defines the conditions, safe boundaries, and the management and administrative controls necessary to ensure the safe operation of the CSTF. The CSTF DSA/TSRs evaluated and described in this SER constitute the Nuclear Safety Rule 10 CFR 830 compliant DSA/TSR.

B. Facility Description

The CSTF are part of the overall High Level Waste Facilities. The CSTF are a group of facilities and support services designed to receive, store, process and safely manage radioactive wastes from production and research facilities at SRS. The CSTF include the F-Tank Farm (FTF) and the H-Tank Farm (HTF).

The CSTF H-Tank Farm is located in H-Separations Area of the SRS near Aiken, South Carolina. The HTF facility consists of three evaporators (242-H, 242-16H and 242-25H), 29 waste storage tanks (9-16, 21-24, 29-32, 35-43, and 48-51), the Filter/Stripper Building (241-96H), the 299-H Maintenance Facility, pump tanks and associated transfer structures/components. The CSTF F-Tank Farm is located in the F-Separations Area approximately 2 miles from the H-Tank Farm. The F-Tank Farm includes two evaporators (242-F and 242-16F), 22 waste tanks (1-8, 17-20, 25-28, 33, 34, and 44-47), pump pits and associated transfer structures/components, including the F/H Inter-Area Transfer Line.

Various support systems such as ventilation, storm water handling, plant/instrument air, steam supply, normal electrical supply, as well as backup diesel generators, are provided to support waste receipt, evaporation, storage, removal, and transfer operations and pretreatment processing.

The CSTF H-Tank Farm receives waste from various sources, the primary ones being H-Canyon, Defense Waste Processing Facility recycle, and Receiving Basin for Offsite Fuels. The F-Tank Farm receives waste from F-Canyon. Both the F-Tank Farm and the H-Tank Farm have Waste Acceptance Criteria, which control the acceptance of these waste streams.

C. Document Content and Conclusions

The CSTF DSA sets forth the deterministic accident analyses; describes design basis accident scenarios considered and analyzed; projects radiological and non-radiological consequences to the offsite public and onsite workers; compares the projected consequences against EGs; and derives the necessary safety class and safety significant features and controls to ensure the design basis accidents are within the applicable EGs. The accidents representing the greatest hazard are waste

tank and transfer line/jacket explosions, aerosolization events, and Natural Phenomena Hazard (NPH) initiated events. Based on the radiological inventory and projected worst case accident consequences, the CSTF is classified as a Hazard Category 2 nuclear facility per DOE-STD-1027-92 (Reference 2).

The CSTF DSA also describes the site and design of the CSTF, with emphasis on the design features serving to prevent accidents from occurring and serving to mitigate the consequences of accidents. The concept of defense-in-depth is utilized in establishing these design features in accordance with DOE-STD-3009-94 (Reference 3). The structures, systems, and components (SSCs) classified as safety class and safety significant are identified, and the process for arriving at these determinations is described. The CSTF DSA chapters also describe the safety programs for protecting the facility workers (e.g., the conduct of operations program, the quality assurance program, and the emergency preparedness program) as well as the management and organizational structure for the CSTF.

The CSTF DSA concludes that the hazard and accident analyses demonstrate that design features, administrative controls, and safety programs are in place to protect onsite workers, offsite public, and the environment from radiological and chemical hazards such that operation of the CSTF presents an acceptable level of risk. The DSA is formatted in accordance with DOE-STD-3009-94 (Reference 3).

The CSTF TSRs set forth the operating limits, surveillance requirements, and administrative controls which are used by facility operators to ensure the CSTF structures, systems, and components are kept within safe performance boundaries and to protect the health and safety of the public and onsite workers from undue exposure to radiological and chemical hazards. The TSRs contain use and application instructions, and provide the bases for the limits, requirements, and controls. The TSRs are formatted in accordance with DOE Guide G 423.1-1 (Reference 4).

The DSA identifies several planned equipment upgrades in the CSTF. Examples of the proposed upgrades include pump tank ventilation system upgrades, loss of power alarms for conductivity probes, automatic transfer isolation, passive ventilation for transfer system components and waste tank ventilation upgrades. These upgrades will either replace or supplement currently credited DSA controls. The DSA does not credit any of these equipment upgrades in the mitigated accident consequences.

D. DOE Review Criteria

The DOE review of the CSTF DSA was performed against the criteria contained in DOE-STD-3009-94 (Reference 3). Review of the CSTF TSRs was performed against the criteria contained in DOE Guide G 423.1-1 (Reference 4). The intent of this TSR review was to confirm the DOE Guide G 423.1-1 requirements were met in terms of content and organization, and that the TSRs were consistent with the derived controls in the DSA. The specific criteria from DOE-STD-3009-94 and DOE Guide G 423.1-1 utilized for this review is identified in SER Section II for each DSA Chapter and TSR section.

DOE recognizes that the CSTF DSA Chapter 18 (Tank 48 Accident Analysis) submitted in Reference 1 is based on a safety analysis previously documented in WSRC-SA-15, Rev. 12 (Reference 5) and approved by DOE as documented in In-Tank Processing Facility SER Revision

4, as supplemented (Reference 6). This SER documents DOE acceptance of that analysis for Tank 48 specifically. References 7 and 8 discuss the WSRC DSA strategy and DOE's acceptance of this strategy.

This SER is prepared by the Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96 (Reference 9) and SRIP 400, Chapter 421.1 (Reference 10). In accordance with SRM 300.1.1A (Reference 11), the SR Manager is the approval authority for this SER.

E. DOE Review Chronology and Methodology

The CSTF DSA (WSRC-SA-2002-00007, Revision 0) and TSRs (S-TSR-G-00001, Revision 0) submitted in Reference 12 were the result of an effort to transition to a safety basis developed in accordance with Nuclear Safety Rule 10 CFR 830. The previous CSTF safety basis (approved and implemented in 1999) was partially compliant in that it lacked complete safety equipment uncertainty analysis, contained engineering judgement in some cases versus quantitative analysis, and some controls were implemented directly into procedures vice through the TSRs. A DOE Review Team was formed to perform a technical review of the CSTF DSA and TSRs submitted in Reference 12. The DOE Review Team that conducted the review is identified in Appendix A. This review was conducted under an approved DOE HLW Review Plan (Reference 13).

The methodology employed for this review consisted of: a Lead Reviewer responsible for overall review of the DSA/TSR and preparation of the SER; monitoring and assessing the Contractor's DSA document development process by the AMHLW-ED AB Technical Advisor; lead horizontal reviewers for performing overall general review of key chapters in the DSA and for the TSRs to ensure the content required by DOE Standards and Guides are satisfied; and lead vertical reviewers for selected accident scenarios to perform an in-depth review of supporting calculations, analyses, and control derivation and vulnerabilities. Independent DOE consultants were also used for review of selective topics. Additionally, an independent support contractor with appropriate expertise was used to perform selected independent reviews and calculations. Independent assessments were performed of (1) the percent hydrogen concentration in trapped gas bubbles based on chemistry of waste, and (2) the basis for level of organics (i.e., concentrations) assumed and release assumptions (liquid-vapor equilibrium values). Select calculations/analyses were reviewed to ensure adequacy of selected controls and inputs, that assumptions were reasonably conservative, and that the approach/methodology used was consistent with applicable standards. Selection of the calculations/analysis for independent review was based on the complexity of the accident scenario, the potential for significant consequences, the extent of technical issues related to the scenario, and the extent of previous reviews of the postulated event.

By letter dated August 16, 2002 (Reference 14), SR transmitted comments to WSRC on the DSA and TSRs submitted in Reference 12. Reference 14 requested WSRC to resolve the comments by incorporating into the DSA/TSR or providing sufficient justification for not incorporating. Reference 14 also noted a general weakness regarding inconsistencies between various sections of the safety basis documents and requested appropriate actions to be taken to ensure consistency in the revised documents prior to re-submittal. DOE transmitted additional comments that were identified during initial preparation of the SER to WSRC for resolution by letter dated September 24, 2002 (Reference 15). The DSA/TSR submitted in Reference 1 adequately addressed the comments in References 14 and 15, except for the Condition of Approval below concerning the

annulus conductivity probes. The DOE review documented in SER Revision 0 ensured that those comments necessary to be resolved prior to DSA/TSR implementation for CSTF were adequately resolved. There were some revisions associated with supporting calculations that will be resolved by correcting the calculation at the next revision of the calculation, since the deficiencies have a minor impact (if any) on the conclusion/results. This is identified as Revision Issue CSTF-0-0-R1 below. DOE concurs that this would be the most cost effective resolution without impacting safety. Subsequent to submitting Reference 1, WSRC identified the need to change an input concerning trapped gas release due to an event on Tank 40 as well as the need to correct an oversight concerning Tank 48. Reference 16 submitted these addendum changes to Reference 1 to address these issues and is evaluated within Sections II.B.9 and II.F of this SER. Additional editorial clarifications were also made in the page changes submitted in Reference 16.

CSTF-0-0-R1: Revise calculations as identified in the enclosure to Reference 1 (Letter, Picollo to Anderson, 11/15/02, HLW-2002-00154). [Revision Issue]

F. DOE Conditions of Approval

The following Condition of Approval was identified (see Section III.D.2.5 of this SER for discussion). The necessary DSA and TSR changes to resolve this Condition of Approval (draft changes shown in Appendix B of this SER) are required to be incorporated into the DSA and TSRs prior to implementation of the DSA and TSRs.

Condition of Approval: Revise all applicable DSA chapters (e.g., 3, 4, and 5) as well as TSR LCO 3.8.5 to designate the Type I, II, III, and IIIA conductivity probes as SS for the purpose of identifying primary tank leakage into the annulus, and to perform the requisite surveillance requirements to ensure these probes are operable for periodic annulus leak detection.

G. Summary of DOE Evaluation

DOE identified one Condition of Approval which will necessitate revision to the DSA and TSR concerning the waste tank annulus conductivity probes for leak detection. With the adequate incorporation of this Condition of Approval, DOE approval is based on the determination that the accident analysis is complete and comprehensive; the derived set of controls are commensurate with the hazards; the design of structures, systems, and components reflects that diversity and defense-in-depth concepts are in place where appropriate; and that all other major programmatic elements covered in the DSA have been deemed adequate to support safe operation of the CSTF. In addition, DOE review of the TSRs concluded that the parameters requiring operating limits, surveillance requirements, and administrative controls have been properly identified and developed, the use and application instructions are appropriate and clear, and the bases contain the proper linkage to the accident analysis documented in the DSA. The risk associated with the potential hazards of operating the CST Facilities is acceptable.

Modifications required to support implementation of the DSA were identified in Attachment 1 to Reference 12. Those modifications were necessary to ensure credited equipment and assumptions in the mitigated accident analysis were protected. Completion of those modifications will be verified during assessment activities associated with implementation of the DSA and TSR.

H. References

1. Letter, Piccolo to Anderson, "Resubmittal of Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements for DOE Approval," (HLW-2002-00154), 11/15/02
2. DOE-STD-1027-92, 12/92 and Change Notice 1, 9/97, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23"
3. DOE-STD-3009-94, 7/94 and Change Notice #2, 4/02, "Preparation Guide for Nonreactor Nuclear Facility SARs"
4. DOE Guide G 423.1-1, 10/24/2001, "Implementation Guide for Use in Developing Technical Safety Requirements"
5. WSRC-SA-15, "Liquid Radioactive Waste Handling Facilities Safety Analysis Report, Addendum 1, Additional Analysis for DWPF Feed Preparation by In-Tank Processing", Rev. 12, April 2002
6. In-Tank Processing Facility SER Revision 4, May 2001, as supplemented
7. Letter, Piccolo to Anderson, "Submittal of the Revised Safety Strategy for Preparation of the Consolidated CST Authorization Basis", HLW-2001-00164, 11/27/01
8. Letter, Anderson to Piccolo, "Safety Strategy for Preparation of the Consolidated Concentration, Storage, and Transfer (CSTF) Safety Basis Documents to Meet 10CFR830", PC-02-012, 12/21/01
9. DOE-STD-1104-96, 2/96 and Change Notice #1, 5/02, "Review and Approval of Nonreactor Nuclear Facility SARs"
10. DOE-SR SRIP 400, Chapter 421.1, 3/1/99, "Nuclear Safety Oversight"
11. DOE-SR SRM 300.1.1A, 5/8/01, "Human Resources Program Management Manual"
12. Letter, Piccolo to Anderson, "Submittal of Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements for DOE Approval", HLW-2002-00086, 6/27/02
13. DOE Review Plan for the Savannah River Site Consolidated Concentration, Storage, and Transfer Facility (CSTF) Safety Basis Document Upgrade To Meet 10CFR830, Revision 0, January 2002
14. Letter, Anderson to Piccolo, "Submittal of Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements for DOE Approval", PC-02-058, 8/16/02
15. Letter, Anderson to Piccolo, "Submittal of Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements for DOE Approval", PD-02-025, 9/24/02
16. Letter, Piccolo to Anderson, "Submittal of Changes to the Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements with DOE for Approval," HLW-2002-00164, 12/11/02

II. Approval Basis

The five approval bases required by DOE-STD-1104-96 are described in Sections II.A through II.E below. Section II.F addresses the unique hazards and controls for Tank 48H located in H-Tank Farm. [Note, references referred to in the text of Section II are provided at the end of that particular Section.]

A. Base Information (DSA Chapters ES, 1, and 2)

The DSA contains sufficient background and fundamental information to support the review of the technical aspects contained in Chapters 3, 4, 5, and the TSRs. Most of the base information is contained in the Executive Summary (ES), Chapter 1 (Site Characteristics), and Chapter 2 (Facility Description). These chapters were reviewed against the DOE-STD-3009-94 criteria and the results have been summarized below.

Executive Summary: The ES describes the mission of the CSTF as the management of liquid radioactive wastes in a manner that prevents release to the environment and minimizes exposure to site workers and the public, and to process liquid wastes for solidification at the Defense Waste Processing Facility (DWPF)/Saltstone. The CSTF was segmented and categorized as Hazard Category (HC) 2, in accordance with DOE-STD-1027-92. Two segments (299-H and Tank 16) were identified appropriately as HC 3. Building 299-H does not contain significant radioactive material inventory or a chemical inventory that exceeds HC2 threshold. Tank 16 has been emptied and removed from service. Additionally tanks 17 and 20 have been emptied and closed and are classified as "Radiological" facilities. The ES briefly describes the CST organization with a summary of the responsibilities of the various managers. The ES describes the facility operations of the Tank Farms, including the waste evaporators, waste transfer systems, and 299-H Maintenance Facility in general terms to support understanding of the significant hazards and how the hazards are classified as Design Basis Accidents (DBAs) and Beyond DBAs. The major hazards are identified as loss of containment due to process or NPH events resulting in a surface release of liquid radioactive waste, and deflagration resulting in an airborne release. The main preventive or mitigative features have been identified as passive primary and secondary containments, ventilation systems, passive ventilation systems, and lower flammability limit monitors.

Chapter 1: Area and site maps showing each tank farm's position relative to the site boundary, waterways, and other facilities, such as the canyons, RBOF, RTF, and ETF, were included. Access control is described as the perimeter fence around the site with access to F and H Areas controlled by fences. The SRS Generic SAR (GSAR, G-SAR-G-00001) was appropriately referenced for general site exclusion areas and other information. Discussion regarding the location where the EGs are applied is included. This chapter describes the CSTF as being greater than 5 miles from the site boundary and, therefore, from the residential population, schools, hospitals, and recreational areas. These areas, as well as the industrial population and casual transients are discussed in great detail in the referenced GSAR. This section also briefly touches on site meteorological data and short and long-term diffusion coefficients as they apply to the CSTF and appropriately refers to the GSAR for more detail. As with the environmental description, natural phenomena threats, including floods, earthquakes, high winds, tornadoes, and lightning strikes are extensively covered in the

GSAR. This chapter briefly summarizes the major external man-made threats with potential to initiate accidents. With respect to interface with other facilities, a brief discussion regarding inoperable reactor facilities and Z-, F-, H-, and E-Areas is presented. The canyons' structures and engineered safety features are credited as providing effective confinement and therefore, have no impact on the CSTF. The DWPF safety analysis was reviewed, and it was determined that design features, administrative controls, and safety programs protect onsite workers, including CSTF personnel and pose no significant risk to the CSTF. RBOF, Saltstone, and the E-Area Burial Grounds were similarly reviewed and found to pose no significant risk. This chapter states that a review of the existing Environmental Impact Statement and Environmental Analyses that address facilities or operations notes no significant discrepancies between the site characteristic assumptions used in the CSTF DSA and those used in the existing environmental analyses.

Chapter 2: The current use of the facility, which is the same as historical and projected future use, is adequately described, including additional information on the operating history of the Tank Farms. The facility configuration is correctly described as including various processing systems and storage systems. The basic processes and principal operations performed and the basic facility layout, waste tanks and waste evaporators are described. Information on key equipment location and arrangement and material of construction for the tanks and evaporators is provided. Key equipment/dimensions/parameters significant to understanding the hazard and accident analyses are included, such as waste tank design parameters and capacities, waste tank ventilation systems, transfer facility (transfer lines, diversion boxes, pump pits, valve boxes, etc.) capacities and drain features, Advanced Design Mixer Pump (ADMP), Slurry Pumps, etc. Safety support systems, such as Fire Protection System, Flammable Gas Monitoring, Airborne Particulate Monitoring, Radiation Monitoring, and Stormwater/Effluent Monitoring are briefly described. The electrical system arrangement and the non-electrical systems (i.e., steam, plant/instrument air, flush/cooling/bearing/inhibited water systems) are also adequately described.

B. Hazard and Accident Analysis (DSA Chapter 3)

B.0 The purpose of this DSA chapter is to provide information that will satisfy the requirements of 10 CFR 830 to evaluate normal, abnormal, and accident conditions, including consideration of: natural and man-made external events; identification of energy sources or processes that might contribute to the generation or uncontrolled release of radioactive and other hazardous materials; and consideration of the need for analysis of accidents which may be beyond the design basis of the facility. This chapter describes the process used to systematically identify and assess hazards to evaluate the potential internal, man-made external, and natural events that can cause the identified hazards to develop into accidents. This chapter also presents the results of this hazard identification and assessment process. Hazard analysis considers the complete spectrum of accidents that may occur due to facility operations; analyzes potential accident consequences to the public and workers; estimates likelihood of occurrence; identifies and assesses associated preventive and mitigative features; identifies safety significant SSCs; and identifies a selected subset of accidents, designated DBAs, to be formally defined in accident analysis. Subsequent accident analysis evaluates these DBAs for comparison with the EG. This chapter covers the topics of hazard identification, facility hazard categorization, hazard evaluation, and accident analysis. Expected products of this chapter, as applicable, based on the graded approach, include:

- Description of the methodology for, and approach to, hazard and accident analyses
- Identification of hazardous materials and energy sources present by type, quantity, form, and location
- Facility hazard classification, including segmentation in accordance with DOE-STD-1027-92
- Identification in the hazard analysis of the spectrum of potential accidents at the facility in terms of largely qualitative consequence and frequency estimates. The summary of this activity will also include:
  - Identification of planned design and operational safety improvements
  - Summary of defense in depth, including identification of safety-significant SSCs and other items needing TSR coverage in accordance with 10 CFR 830
  - Summary of the significant worker safety features, including identification of safety-significant SSCs and any relevant programs to be covered under TSR and administrative controls
  - Summary of design and operational features that reduce the potential for large material releases to the environment.
  - Identification of the limited set of unique and representative accidents (i.e., DBAs) to be assessed further in accident analysis.
- Accident analysis of DBAs identified in the hazard analysis. The summary of this activity will include for each accident analyzed, the following:
  - Estimation of source term and consequence.
  - Documentation of the rationale for binning frequency of occurrence in a broad range in hazard analysis (detailed probability calculations not required)
  - Documentation of accident assumptions and identification of safety-class SSCs based on the EG.

B.1 Criteria: DOE-STD-3009-94, para. 3.1, Introduction, and 3.2, Requirements

This section provides an introduction to the contents of this chapter and includes the objectives and scope specific to the chapter as developed. This section lists the design codes, standards, regulations, and DOE Orders which are required for establishing the safety basis of the facility. SRIDS may be referenced as appropriate.

Evaluation

Section 3.1 of Chapter 3 describes the purpose and scope as the identification and assessment of potential hazards and accidents associated with CSTF and the identification of safety class and safety significant SSCs and administrative controls necessary to protect the onsite and offsite population. Section 3.1 also provides an accurate overview of the remaining sections within Chapter 3. DSA section 3.1.2.4 (Selection of Inputs and Assumptions) discusses the objective of selecting "reasonably conservative" values versus bounding values. This approach was documented in Reference B.1 (DSA Safety Strategy) and accepted by DOE in Reference B.2 (DOE Letter approving safety strategy). The criteria used to establish reasonable and conservative values is described in the DSA. To confirm the values satisfied the criteria, a Safety Inputs Review Committee (SIRC), comprised of senior level management personnel experienced in safety analysis and CST facilities, reviewed the inputs and assumptions for each accident scenario. The SIRC also reviewed the accident scenarios to ensure they were

reasonably realistic yet conservative. DOE monitored this process to ensure appropriate application of the established criteria.

Section 3.2 of Chapter 3 presents a comprehensive list of DOE Orders, Standards and Guides used to develop this chapter. The computer codes used in Chapter 3 are not discussed in section 3.1, but are discussed in section 3.4.1 (see SER Section II.B.9 for evaluation).

Based on DOE reviews, the criteria to provide objectives and scope and to list relevant requirements documents has been met.

B.2 Criteria: DOE-STD-3009-94, para. 3.3.1, Methodology

This section identifies the method used by analysts to identify and inventory hazardous materials and energy sources in terms of quantity, form, and location associated with facility processes or associated operations. The method used to screen out standard industrial and insignificant hazards is presented.

Evaluation

The Hazard Analysis was performed by a Hazard and Operability Analysis (HAZOP) team comprised of facility and system cognizant engineers (subject matter experts), analysts experienced in hazards analysis, operations and maintenance personnel with extensive knowledge of the CST facilities, and CSTF management personnel. The HAZOP technique and "What-if" process were used to identify the potential for both human and equipment errors. The CST Facility was divided into process locations (e.g., evaporators, waste transfer systems, waste tanks, etc.) to ease in the identification of hazards and selection of mitigative features. The sources of information for identifying and inventorying hazardous materials and energy sources include existing project, safety, and environmental documents; design drawings and reviews; facility walkdowns and equipment data; and consultations with facility system and process experts. Not stated in this section, but instead later in section 3.3.3.1.3 (Review of Past Relevant Operating History), the Site Item Reportability and Issue Management (SIRIM) Program database was also reviewed for significant abnormal events, from 1991 to present. DOE reviewed the SIRIM database and did not identify any new events not covered by existing events in the Hazards Analysis (HA) or not covered by worker protection program requirements (e.g., lockout/tag-outs (Manual 8Q), access control (RadCon program), etc.). Prior to 1991, the Waste Management Fault Tree Data Storage and Retrieval Database was searched for incident reports and hazards investigation. DOE previously reviewed the database as part of the previous safety analysis reviews and found the appropriate events were considered. New accident initiators are identified through the New Information (NI), Potential Inadequacy in the Safety Analysis (PISA), and Unreviewed Safety Question (USQ) processes.

The approach to hazard evaluation laid out and justified each step of the evaluation, including identifying systems/subsystems, hazard/energy sources, potential event sequences, target/potential consequences, prevention/detection/mitigation features, consequence and probability category levels, and risk rank, which are then built upon in the Hazard Analysis Results section. This approach is consistent with guidance in DOE-STD-1027-92 for the type of facilities, with respect to hazard level and complexity, represented in the HA.

Hazards were screened to determine: if they are routinely encountered first-hand by the general public in the home, home workshop, or public places; if public consensus standards exist to control the hazard; if there is evidence that public or employee concern exists about the hazard beyond normal prudence; and if the hazard is subject to Occupational Safety and Health Administration (OSHA) regulations or one or more national consensus standards (e.g., ASME, ANSI, NFPA, IEEE, NEC). DOE reviewed this screening process and results and found them to be adequate. Industrial hazards are formally managed in accordance with WSRC Procedure Manual 8Q, which defines basic site-wide safety policies and minimum requirements. This manual requires compliance with DOE Orders and OSHA regulations and is an appropriate interface with the hazards analysis.

Based on DOE review, the criteria to identify and justify hazard screening methodology has been met.

B.3 Criteria: DOE-STD-3009-94, para. 3.3.2.1, Hazard Identification, and 3.3.2.2, Hazards Categorization

A summary table identifying hazards in terms of quantity, form, and location is to be provided. The basic set of radionuclides, hazardous chemicals and flammable and explosive materials used or potentially generated in facility processes should be identified, and any mechanical, chemical, or electrical source of energy that may influence accident progression involving such materials are included. The facility hazards classification and where segmentation has been employed, the segment boundaries and individual segment classification are included and is justified.

Evaluation

Reference B.3, Calculation S-CLC-H-00858 (Hazard Analysis for the CST Facility), presents the hazards and their potential energy sources for waste tanks (including tank support systems), transfer facilities (including auxiliary systems), evaporator systems, and the 299-H Maintenance Facility. Potential event sequences and types of consequences are briefly described. DOE compared the hazards and postulated events identified in Reference B.3 to DOE/TIC-11603, DOE Order 6430.1A, LA-10294-MS, DOE-STD-3009-94, DOE-STD-1027-92, and DOE-HDBK-1100-96 and concluded a full range of events were identified for consideration. The events are categorized according to the consequence type, such as fire, explosion, loss of containment/confinement, radiological/chemical, nuclear criticality, external, and natural phenomena. The DSA references the HA calculation and provides tables summarizing those HA events that were considered for further analysis or those events with consequences warranting worker protection controls. DOE review ensured the appropriate HA events were considered in the accident analysis and control selection process.

Quantities of Material at Risk (MAR) are identified in each accident analysis in DSA section 3.4. The radiological content of each of the identified waste streams within the CST Facility is provided in Table 3.4-8. DOE assessment of the radioactive MAR is discussed below in SER Section B.9. Hazardous chemicals in the high level waste are identified in Tables 3.3-5 and 3.3-6 of the DSA. These Tables were developed from G-TRT-G-00003, Rev. 4 (Chemical Inventory Control Program) and the HLW Material Control Monthly Inventory Summary (1999/2000/2001). A chemical compatibility study was conducted and documented in the

Hazards Analysis to identify additional events that could result from mixing of two hazardous chemicals. A matrix was developed and documented in the Hazards Analysis (S-CLC-H-00858) to indicate those combinations to be further addressed in the Hazards Evaluation. The mixing of nitric acid with diesel fuel or gasoline was shown to have the most potential hazard. The study was found to thoroughly assess those potential chemical hazards within the CST Facility. DOE reviewed these source documents and found the development of hazardous chemical concentrations to be based on sample data and process knowledge and to be reasonable and conservative.

Facility segmentation was applied, as permitted by DOE-STD-1027-92, provided the hazardous material in one segment could not interact with hazardous material in another segment. Justification was provided to show waste storage and processing tanks, waste transfer systems, and evaporators as Hazard Category 2. Waste Tank 16 is identified as Hazard Category 3 since this tank has been emptied and physically isolated from the rest of the H-Tank Farm. The 299-H Maintenance Facility is also identified as Hazard Category 3 since the only connection to the H-Tank Farm is through a transfer line from the Waste Collection Tank into the H-Canyon header and on into Pump Tank HPT-5. Transfer of waste from HPT-5 back to the 299-H Facility is not a recognized Tank Farm activity and would require significant physical/procedûral changes. Thus, sufficient isolation exists to treat 299-H as a separate segment. Waste Tanks 17 and 20 have been emptied and operationally closed and are classified as radiological facilities.

The hazard identification and categorization of the CSTF was reviewed and found to be in alignment with DOE-STD-1027-92.

Based on DOE review, the criteria to identify and classify hazards has been met.

B.4 Criteria: DOE-STD-3009-94, para. 3.3.2.3.1, Planned Design & Operational Safety Improvements

Planned improvements not yet implemented are identified and the basis for committing to the improvement, and, if needed, any interim controls proposed until the improvement is implemented, is summarized.

Evaluation

DSA section 3.3.3.3.1 refers to Table 3.3-16, which identifies the planned equipment upgrades in the CSTF. Examples of the proposed upgrades include: pump tank ventilation with flow interlocks supplied by diesel generators to prevent pump tank explosions; loss of power alarm in the control room for leak detection conductivity probes; automatic isolation of incoming waste streams to pump tanks upon high pump tank level to prevent overflow; interlocks with alarms to stop transfers upon identification of a leak from the primary containment to minimize the quantity leaked and prevent buildup of flammable vapors in the secondary containment; passive ventilation for pump tanks/pits, valve boxes, and diversion boxes to prevent explosions due to leaked material; and waste tank ventilation upgrades including flow instrumentation and interlocks, NPH qualification, and backup power. Each of the planned upgrades in Table 3.3-16 refers to the DSA credited controls, which will be replaced and/or supplemented by the upgrades. The DSA does not credit any of these equipment upgrades in the mitigated accident

consequences. The justification and/or benefits of the proposed upgrades are shown in Table 3.3-16, and include: reducing consequences to within EG's; eliminating operator controls; ensuring compliance with DOE O 420.1 design requirements; reducing/eliminating equipment vulnerabilities; and complying with the control selection hierarchy (as defined in WSRC Manual E7, Procedure 2.25). DOE review of the justifications given in Table 3.3-16 and/or the referenced DSA text concluded the risks posed by the vulnerabilities were acceptable. In some cases, no controls were judged necessary prior to the planned upgrades being accomplished. For example:

a. leak detection conductivity probes in non-Pump Pit locations do not have loss of power alarms – this was justified in that the probes in these locations were only a 2nd level of control (1st level of control was passive core piping)

In some cases, additional controls were provided to minimize the risk. For example:

a. requiring backup ventilation on certain pump tanks for certain transfers and increased operator surveillance on installed ventilation system to ensure pump tank does not reach 100% LFL if installed ventilation system fails
b. limiting number of waste tanks to four (4) which could reach 100% LFL in $\leq$ 24 hours from release of trapped hydrogen
c. prohibit the use of certain transfer lines until they are modified to have the requisite leak detection provisions

Modifications required to support implementation of the DSA were identified in Attachment 1 to Reference B.5. Those modifications were necessary to ensure credited equipment and assumptions in the mitigated accident analysis were protected. That attachment was reviewed and found to be comprehensive. Completion of those modifications will be verified during assessment activities associated with implementation of the DSA and TSR.

Based on DOE review, the criteria to identify planned design and operational safety improvements has been met.

B.5 Criteria: DOE-STD-3009-94, para. 3.3.2.3.2, Defense in Depth

Significant aspects of defense-in-depth are summarized, and associated safety-significant SSCs and other items needing TSR coverage are identified and distinguished from SSCs contributing to Defense in Depth (DID). Facility design and administrative features of defense-in-depth are included.

Evaluation

DSA section 3.3.3.3.2 discusses defense-in-depth, and concludes that the SC features/controls identified in section 3.4.2, the safety significant features/controls identified in section 3.4.2 and Tables 3.3-13 through 3.3-15, and the non-safety features/controls identified in the HA provide sufficient defense in depth. Section 3.1.1 states there were no formal "non-SC/SS DID" items required to meet WSRC Manual E7, Procedure 2.25. A WSRC evaluation of the need for non-SC/SS DID was documented in Reference B.12. DOE assessment of the results of the DBAs in section 3.4.2, and review of Reference B.12, concluded this determination was appropriate. Table B.2 in this SER documents the DOE assessment to derive this conclusion. In particular,

for those DBAs which have non-negligible offsite or onsite mitigated doses, Table B.2 shows the effects of non-credited DID which exists.

Facility procedures and personnel training provide the primary DID administrative controls. In addition, site-wide DID Administrative Features include: administrative procedures governing facility safety responsibility and authority, equipment control, procedure adherence, conduct of operations, and control of modifications; operating and maintenance procedures governing operation of facility systems/equipment, surveillances, and preventive/corrective maintenance; and other programs including Industrial Hygiene Program, Industrial Safety Program, Radiation Protection Program, Quality Assurance Program, Configuration Management, Fire Protection Program, etc.

DSA Paragraph 3.4.1.5.2 identifies inactive CSTF locations that were not included in the accident analysis due to their minimal source term contribution and inactive status. The DSA states that facility and worker safety associated with these inactive areas is ensured through application of the general programs and procedures described in DSA section 3.3.3.3.2 (e.g., Radiological Control Program, Industrial Hygiene Program, Quality Assurance Program, Configuration Management Program, and other DID Administrative Features listed above). DOE concurs that the general programs are applicable and are adequate to ensure worker and facility safety with regard to these inactive areas.

Based on DOE review, the criteria to summarize defense in depth aspects has been met.

B.6 Criteria: DOE-STD-3009-94, para. 3.3.2.3.3, Worker Safety

Major features protecting workers from the hazards of facility operation, exclusive of standard industrial hazards, are summarized and administrative features in terms of the programmatic elements covered in later chapters of the DSA are categorized.

Evaluation

Section 3.3.3.3.3 of DSA Chapter 3 appropriately references safety class and safety significant SSCs and Administrative Controls to prevent unacceptable consequences to workers in the immediate area of the hazards and workers outside of the physical area containing the hazard. Table 3.3-12 identifies those HA events that did not require SC or SS controls. Tables 3.3-13 through 3.3-15 identify those HA events qualitatively shown to require SS controls for worker protection (SSCs or administrative control) to reduce the consequences or frequencies to an acceptable level. The controls and their associated safety functions are also identified in these tables. Programmatic administrative controls include: Criticality Protection Program, Fire Protection Program, and Event Response Program. These programs have previously been found to be adequate (DOE SER Rev. 1 for LRWHF SAR). DOE review of the hazards analysis in S-CLC-H-00858, Rev. 2 (Reference B.3), DSA Chapters 4 and 5, and the TSR finds worker protection features adequately identified.

Based on DOE review, the criteria to summarize major worker protection has been met.

B.7 Criteria: DOE-STD-3009-94, para. 3.3.2.3.4, Environmental Protection

Pathways for uncontrolled release to the environment are documented and potential consequences and preventive and mitigative features associated with those pathways are qualitatively estimated.

Evaluation

Section 3.3.3.3.4 of the DSA describes appropriate controls and operating practices that provide protection for on-site and off-site individuals, which also afford protection to the environment. These features include forced ventilation with filtration on waste tanks, pump pits/tanks, evaporator cells, and some diversion boxes; the function of the Effluent Treatment Facilities (not part of the CSTF); stormwater monitoring and diversion to retention basins; secondary containments; shielding; area radiation monitors; conductivity probes; and several administrative controls. This section also includes reference to a site action plan that provides for downstream radioactive sampling and stormwater runoff control and monitoring to minimize/prevent the potential of any release reaching the Savannah River. The DSA recognizes that there are non-DSA related legally enforceable notification and response requirements for releases of hazardous or radioactive materials.

Based on DOE review, the criteria to document environmental release pathways, associated consequences, and mitigators has been met.

B.8 Criteria: DOE-STD-3009-94, para. 3.3.2.3.5, Accident Selection

Accidents to be further evaluated are to be identified and the process for selecting these accidents should be described.

Evaluation

Section 3.3.3 of Chapter 3 describes the results of the HA process and discusses the process used to arrive at the accidents to be considered for detailed analysis (section 3.4 of the DSA). DOE reviewed DSA section 3.3.3 and found it consistent with the results of the HA. Table 3.3-17 identifies those HA events requiring additional analysis. The process used to select the events requiring further detailed analysis was found to be consistent with the guidance given in DOE-STD-3009-94 and DOE-STD-1027-92. Thus, the criteria for describing the accident analysis selection process and results has been met.

Additionally, DOE reviewed the DBAs analyzed in the Hanford Tank Farm and the SRS H-Canyon Authorization Bases to ensure applicable events were considered in the CSTF HA and carried forward, as appropriate, into the CSTF accident analysis (Ref. B.11). The conclusion reached was that applicable events were properly assessed and carried forward in the CSTF DSA.

DOE review of DSA section 3.3.3 concluded an adequate and appropriate set of accidents were identified to (1) identify the necessary worker protection controls, and (2) identify those

significant hazards warranting more detailed analysis for derivation of safety class and/or safety significant controls.

B.9 Criteria: DOE-STD-3009-94, para. 3.4.1, Methodology

Computer codes used to quantify the consequences of operational accidents, natural phenomena, and external events are identified and described. Methodology used to estimate radiological or other hazardous material source terms for DBAs is documented, and includes: 1) the basic approach for estimating physical facility damage from DBAs; 2) the general basis for assigning Material-At-Risk (MAR) quantities; and 3) the basis for material release and respirable fractions or release rates used. Methods used to estimate dose and exposure profiles include meteorological conditions, time dependent characteristics, activity, and release rates or duration for radioactive or other hazardous materials that could be released to the environment and are documented.

Evaluation

The primary computer codes identified in section 3.4.1 of Chapter 3 are: STATPAC, CAFTA, ETA-II, MACCS, ALOHA, and DEGADIS. These codes and models are accepted industry standards, and have previously been evaluated and found to be appropriate for application at the CSTF (DOE SER Rev. 1 for LRWHF SAR).

STATPAC, CAFTA and ETA II are standard statistical/fault tree analysis codes. No unique issues were noted at CSTF that would challenge the validity of their use.

The MACCS code, which realistically accounts for deposition of airborne radioactive releases on the site, is used throughout SRS and the DOE Complex for accident analysis consequence determinations. The MACCS code was developed by Sandia National Laboratory and has been shown to meet the necessary software Quality Assurance requirements (Reference B.4). A comparison between MACCS and other air dispersion models used throughout the DOE complex is documented in report WSRC-MS-97-0477 and shows that MACCS is appropriate for use in safety analysis applications. Based on these considerations, DOE found use of the MACCS code acceptable for the CSTF. The ALOHA code, used for chemical releases, is a standard industry code, used extensively in the Emergency Preparedness program, and was previously reviewed and approved for use in the DWPF SER.

Dose conversion factors are based on Federal Guidance Report 12 for shine dose and International Commission on Radiological Protection (ICRP) Publications 68 and 72 for inhalation 50-year cumulative effective dose equivalent (CEDE). These factors are consistent with DOE-STD-1027-92 and DOE-HDBK-3010-94 and are appropriate for CSTF accident evaluations. Reference B.6 approved the use of ICRP-68/72 for accident analyses.

Component failure was estimated using the following documents: WSRC-TR-93-262, Savannah River Generic Data Base Development; AIChE, Center for Chemical Process Safety, Guidelines for Process Equipment Reliability Data with Data Tables; and DP-1633, Component Failure Rate Data with Potential Applicability to a Nuclear Fuel Reprocessing Plant. For process events where no data exists, a fault tree analysis was used. CAFTA and ETA-II are the computer codes that were used to perform the fault/event tree analyses.

DSA section 3.4.1.5 discusses the development of the material at risk (MAR) radiological constituent concentrations used in the individual accident scenarios. MAR quantities were based on historical information, where available, and reasonably conservative assumptions. The radiological content of a particular waste stream is represented and controlled by the dose concentration potential (in rem/gallon). Thus, the isotopic distribution, sludge solids density, sludge solids weight percent, or supernate density may vary for a particular waste stream as long as the inhalation dose potential meets the limit for that particular category. DOE reviewed the derivation of these waste stream rem/gallon values and concluded they were reasonably conservative. Examples of conservatisms employed are:

1. Sludge slurry value (1.5E9 rem/gal) combines the worst sludge radioactive constituent concentration from any tank of the 10 significant dose contributors (i.e., developed a "supertank" sludge value)

   Calculation X-CLC-H-00305 was performed to assess the need for controls on H-Area waste tanks so that the bounding sludge slurry inhalation dose potential is not exceeded. This calculation demonstrates that with the concentrations and masses of sludge currently present in the H-Area waste tanks (based on the Waste Characterization System data), the sludge cannot be slurried to the weight percent necessary to exceed the 1.5E9 rem/gal inhalation dose potential. DOE has reviewed this calculation and found the inputs and assumptions to be reasonable and consistent with other safety analysis applications (e.g., sludge solids weight percent in sludge slurry of 16.7 wt%; density of sludge solids of $5g/cm^3$; ICRP 68 and 72 dose conversion factors; etc.).

   Similarly, report WSRC-TR-2002-00260 concluded that none of the F-Area waste tanks would even exceed 2.0E8 rem/gal as long as the wt% solids did not exceed 16.7%. This wt% solids limit is controlled in the DSA and TSRs.

2. Supernate value (9.8E7 rem/gal) combines the worst supernate radioactive constituent concentration from any tank of the 10 significant dose contributors, then doubles each concentration, plus includes an assumed 1wt% sludge carryover of the "supertank" sludge in item 1
3. Evaporator values (3.3E7 and 3.7E7 rem/gal) uses the supernate value in item 2, but replaces the 1wt% "supertank" sludge carryover term with 1wt% of Tank 32H sludge (worst case evaporator feed tank sludge)

Liquid releases estimated a reasonably conservative maximum spill volume of 15,000 gallons. This volume was determined assuming a flow rate of 250 gpm continues with no operator action taken for 60 minutes (NRC NUREG-0800 guideline is 30 minutes). 15,000 gallons is equivalent to approximately 4 inches of waste in a waste tank. Although scenarios could be postulated that would result in higher flow rates and/or longer response times, the maximum spill volume is considered a reasonably conservative value such that it would be detected and mitigated prior to exceeding this volume. Leaks or spills can be detected by several means in the facility, including periodic material balances, personnel in the field, and numerous instruments in the facilities. The following controls are credited in the DSA to protect the maximum missing waste assumptions of 15,000 gallons: 1) safety class transfer piping, 2) safety significant leak detection for high-rem transfers, 3) monitoring for transfer events and

material balances during the transfer, 4) limited use (batch transfers of <15,000 gallons)of high flow pumps, 5) alignment and verification of transfer path, 6) verification of transfer termination equipment, and 7) radiation protection program. Available defense in depth instruments include Reel Tapes, ARMs, Continuous Air Monitors (CAMs), Dip Tubes, Conductivity Probes, and Storm Water Monitors (not all of these features are present to detect waste in each location). Under normal conditions, these indications will inform the operator that an upset is in progress well before 3,000 gallons have been released.

Some DBAs rely upon a release rate in calculating consequences, rather than a total volume. The different release rates result in different operator response times. DSA Chapter 13 discusses the human factors evaluation with respect to the operator response times. For DBAs that rely upon a release rate, the following values will be used:

- A flow rate of 360 gpm (with a response time of 15,000 gal/360 gpm = 41 min.) will be used for an above ground leak.
- A flow rate of 250 gpm (with a response time of 15,000 gal/250 gpm = 60 min) will be used for pump tank (non-seismic), annulus, and waste tank overflows, as well as transfer errors into a box (VB, DB, PP, etc.).
- A flow rate of 125 gpm (with a response time of 15,000 gal/125 gpm = 120 min) will be used for seismic pump tank overflow (125 gpm is taken from records of actual transfers into pump tanks).

Given that historically achievable flow rates range from approximately 75 gpm to approximately 125 gpm, DOE concurs that the assumed release rates for the various scenarios are reasonable and conservative.

High Efficiency Particulate Air (HEPA) filters are conservatively assumed to contribute a total activity of 1Ci of Cs-137 for each HEPA filter. This activity is based on an amount of supernate resulting in 1Ci of Cs-137 loading on the HEPA. The activity (in Ci of Cs-137) due to sludge/slurry is determined by taking the ratio of Cs-137 to the other isotopes in the waste.

Meteorological conditions assumed for dispersion are consistent with wind data collected at SRS since 1965. Consistent with DOE-STD-3009-94, offsite dose consequences were calculated using 95% meteorology. Onsite dose calculations were calculated using 50% meteorology, consistent with SRS site practices based on guidance from DOE in development of the RTF SAR (Reference B.7).

DOE-HDBK-3010-94 was appropriately used for guidance for determination of Airborne Release Fractions (ARF), Respirable Fractions (RF), Damage Ratio (DR), and Leak Path Factors (LPF), which were documented for each DBA. The material released is based on historical data and reasonably conservative assumptions. Composition of materials involved in an event was based on the calculated concentrations in various process solutions. Dose and exposure profile estimates for both radiological and chemical source terms were documented and included appropriate and reasonable assumptions of meteorological conditions, duration of releases, operational activities, and time dependent characteristics. Frequency determination methodology, human reliability analysis, and mechanistic models, such as aerodynamic entrainment/re-suspension, emission rate models and generation of energy due to the source term, are adequately described.

Section 3.4.1.5 of the DSA provides discussion of general inputs and methodologies which are used in a variety of the accident scenarios. Included are the following key topics:

1. Temperature correction of H_2 LFL and LEL
   The equation to adjust the H2 LFL/LEL based on temperature uses an attenuation factor of 0.0011 based on Reference B.8. DOE investigation found another source (Reference B.9) which derived an attenuation factor of 0.0033 (which is more conservative). Neither source was found to have more stature than the other (e.g., NFPA code does not discuss temperature correcting the LFL/LEL). Based on the following rationale (which is given in report WSMS-SAE-M-02-0185) showing sufficient conservatisms in overall analyses, DOE concluded that maintaining the use of an attenuation factor of 0.0011 was acceptable.

   a) The temperature correction was minimal as used (only a temperature delta range for correction of approximately 100°C in CST applications) and the difference between attenuation factors is less than 1% H_2 (<25% LFL). The actual temperature correction expected is much less than this in real life cases, and the temperatures have been conservatively considered. Thus, even smaller correction is actually expected.
   b) It was not found that either factor is supported by data for upward propagating burns. The 0.0011 factor is supported by data for downward propagation. The 0.0033 value is a theoretical value based upon the Burgess Wheeler law. Hydrogen has properties, such as a non-constant flame temperature, which may lead to a different slope or curve for temperature correction for upward propagation. Actual data might actually support the 0.0011 slope more than the 0.0033 slope. The effects are theorized to be driven by hydrogen diffusion, convection, and buoyancy for upward propagation. It is known that hydrogen behaves differently than other gases such as methane, ethane, etc. for which the Burgess Wheeler Law does work. Use of the downward slope 0.0011 value is supported by data giving it some credence over the theoretical value of 0.0033.
   c) The use of 4% H_2 as the lower limit for deflagration is conservative relative to significant pressure rise or temperature rise. At least another 1% to 1.5% hydrogen, offsetting the less than 1% H_2 difference due to the attenuation factor difference, is usually needed for tests to show ignition. For example, the smallest hydrogen percent showing burn in the EPRI tests (Ref B.10) for example was 5.54% on spark ignition and 4.86 with glow plug ignition.
   d) The CST analysis is conservative with respect to the effect of moisture content in the gas space. It is expected that moisture content, which was not considered in the CST analyses, will offset the temperature attenuation coefficient difference of less than 1% H_2 in almost all cases
   e) When source terms are calculated, they are conservative assuming complete combustion, with conservative terms in all the elements of the five factor formula. This tends to offset the less than 1% H_2 difference (25% LFL) caused by the two attenuation coefficients over the range of temperatures applied for CST.

2. H_2 radiolytic generation rate

   DOE reviewed the supporting analysis for the hydrogen generation rate equation given in DSA section 3.4.1.1.2 and found the methodology consistent with source information from laboratory measurements of hydrogen production from radiolysis, including the effect (suppression) of nitrates and nitrites on hydrogen generation. Source documents reviewed included:

   - Journal of Physical Chemistry, "Curium-244 Alpha Radiolysis of Nitric Acid. Oxygen Production from Direct Radiolysis of Nitrate Ions," Bibler, 1974
   - WSRC-TR-98-00303, Rev. 0, "Hydrogen Generation Rates for Tank Farm Applications," December 1998
   - Bureau of Mines Bulletin 627, "Flammability Characteristics of Combustible Gases and Vapors," 1965
   - WSRC-RP-91-1171, "The Dependence of Radiolytic H2 Generation on the Nitrate Concentration in High Level Waste Solutions," Nov. 19, 1991
   - WSRC-TR-96-0109, "Hydrogen Generation by Radiolysis of Tetraphenylborate Solutions and Slurries," Rev. 0
   - The Radiation Chemistry of Water and Aqueous Solutions, A. A. Allen, Ph.D., 1961
   - M-CLC-H-01796, "Hydrogen Production Due to Alpha Radiolysis," 10/98
   - SRT-LWP-93-022, "Time to Reach LFL in ESP Sludge Batch One," April 1993
   - S-CLC-G-00235, Rev. 2, "Input Data and Assumptions for the Concentration, Storage, and Transfer Facilities," April 24, 2002
   - WSRC-TR-2001-00193, "Radiolytic Bubble Gas Hydrogen Compositions," April 2001
   - HLW-STE-2002-00361, "Reliability of WCS Hydrogen Generation Rate Estimates," September 18, 2002

   Based on the DOE review, the methodology provided in DSA section 3.4.1.1.2 for determining the hydrogen generation rate and the time to reach 100% CLFL is conservative.

3. Dissolved H_2 release due to change in supernate temperature

   Increases in supernate temperature and decreases in ionic strength decreases the solubility of H_2. Thus, for events involving steam jet transfers of dilute supernate (which could increase the supernate temperature as much as 20°C), or the heat up of evaporators up to 100°C, the change in H_2 solubility is accounted for. The change in H_2 solubility is based on standard H_2 chemistry (see WSRC-TR-98-0423) as was found to be reasonable and appropriate.

4. Sludge carryover in supernate and evaporator-related MAR

   The amount of sludge carried over into supernate (includes evaporator stream) from transfer jets and transfer pumps is assumed to be 1wt% solids. The 1wt% sludge solids is the major contributor to the dose potential of supernate and evaporator-related streams. DSA section 3.4.1.5.1 discusses the basis for this input. DOE reviewed this basis and the supporting calculations/reports and concluded the 1wt% solids value was appropriate and conservative, and is consistent with experience, limited sample results, and fluid flow models of pumps/jets. The 1wt% solids carryover is based on transfer jets/pumps being maintained at least 24" above the sludge level (as well as restrictions on not slurrying while transferring), which is properly recognized as a control in DSA section 3.4.1.5.6.

5. Trapped H_2 values (retention and release)
   DSA section 3.4.1.5.3 provides the retention and release values for trapped H_2 gas in supernate, saltcake and sludge under various mechanisms of disturbance (e.g., salt dissolution, sludge mixing, seismic). These values are used in determining the potential to reach flammable conditions in waste tanks and pump tanks post-seismic as well as from planned activities such as slurry pump operation or saltcake dissolution. Several of the key parameters are discussed below.

   Report WSRC-TR-2002-00137 summarizes the previous data and reports concerning the volume of trapped gas in saltcake and sludge and the amount of the trapped gas which is estimated to be released from a seismic event. DOE review of this report concluded it utilizes the available pertinent data and provides a reasonable and conservative basis for deriving the values.

   Report WSRC-TR-2001-00193 provides the methodology for determining the percent H_2 within the trapped gas bubbles. DOE review of this report found it to have a sound basis, including the comparison made between the predicted H_2 percentage and the observed results from limited experiments with actual and synthetic wastes.

   Calculation S-CLC-G-00235 (Input IPR0148a) documents the basis for the input that a single slurry pump (in Type I, II, and III/IIIA tanks) can agitate 50% and the ADMP can agitate 100% of the sludge in the tank. DOE review of the supporting reports concludes this is conservative for tanks that have not been fully slurried before. Reference B.15 documents an addendum change to DSA section 3.4.1.5.3 that for slurried sludge tanks (i.e., tanks that are under a Quiescent Time Program), one pump can agitate 100% of the sludge. This change is conservative and appropriate.

   Calculation S-CLC-G-00235 (Input IPR0149a) documents the basis for the input that one gallon of water will dissolve 1 gallon of saltcake. DOE review of the supporting reports concludes this is conservative (previous analyses had estimated a ratio of 2.4:1 or 1.12:1; using a 1:1 ratio is conservative).

6. Organic contribution to flammable gas accumulation and release
   The following inputs are given in DSA section 3.4.1.5.3:
   a) 5% CLFL (0.2 vol% H_2) for streams other than Canyon PVVS flushes (or similar) to determine if the vapor space being evaluated can reach LFL/LEL
   b) 0.96 vol% H_2 for energy effects from streams other than Canyon PVVS flushes (or similar) to determine amount of waste vaporized if vapor space reaches LFL/LEL in event being evaluated
   c) 20% CLFL (0.8 vol% H_2) for Canyon PVVS flushes (or similar) to determine if the vapor space being evaluated can reach LFL/LEL
      [to account for the energy effects from Canyon PVVS flushes, 2.64vol% H_2 would have to be added; however, since the receipt tank (pump tank) explosion already exceeds the onsite EG and is prevented with safety significant controls, consequence calculations do not run this case.]

DOE reviewed the source documents deriving the above values (S-CLC-G-00270 and WSRC-TR-2002-00094) and concluded the 5%/20% LFL values are conservative and bound samples taken in a variety of pump tanks, waste tanks, and evaporators.

Additionally, DOE reviewed the derivation of the 0.96 vol% H_2 for energy effects. The process employed in the DSA is to add 0.96 vol% H_2 (and convert this to moles of H_2 then to kcals of energy) to account for the presence of each organic vapor species and its moles and kcals of energy. DOE assessment concluded that if each organic species moles were individually derived and converted to kcals of energy, this would result in ~1% greater energy than using 0.96 vol% H_2 and converting this H_2 to moles and kcals (Reference B.16). Thus, DOE concluded the approach employed in the DSA was adequate.

7. Atmospheric breathing of tanks and boxes/cells due to barometric pressure changes
For determining the "residual" waste which can be in secondary containment locations (e.g., diversion boxes, pump pits, valve boxes) or for determining whether a waste tank can reach steady-state LFL/LEL, the DSA credits the fact that these locations undergo "breathing" due to atmospheric pressure changes. This "breathing" basically equates to a low ventilation rate. DOE evaluated the basis for this assumed "breathing" and concluded it is reasonable to include in long term applications (weeks and months). Given the applications are over substantial time periods, the DSA use of the mean pressure fluctuation (5 mbar/day) is appropriate. Additionally, calculation S-CLC-G-00291 shows that the opening size required to allow the passive "breathing" to take place (0.1 in^2 for volumes on the order of 1 million gallons) is such a small fraction of the surface area of exposed sections of the tanks, boxes, pits, etc. that no specific control on opening size is warranted.

8. High-Rem and Low-Rem Transfers
High-Rem waste transfers have an inhalation dose potential of greater than 2.0E+08 rem/gallon while Low-Rem waste transfers have an inhalation dose potential of less than, or equal to, 2.0E+08 rem/gallon. By distinguishing between these two types of transfers, controls are established that are commensurate with the level of risk (i.e, less controls for Low-Rem transfers due to lower consequences). All supernate and evaporator transfers are shown to be Low-Rem based on the low sludge component (see calculation U-CLC-G-00002). Transfers from Type IV tanks were also shown to be Low-Rem in calculation X-CLC-G-00025. Report WSRC-TR-2002-00260 assessed F-Area sludge slurry transfers and concluded that none of these transfers from existing F-Area tanks containing sludge would jeopardize the Low-Rem limit at 16.7 wt% solids. The DSA and TSRs have properly included a restriction to support this conclusion by requiring all F-Area sludge slurry transfers to be $\leq$ 16.7wt% solids. Additionally, all F-Area waste tanks except Tanks 33 and 34 are not required to be sampled after slurrying but before transferring to verify the transfer would be within the Low-Rem limit. Given the higher dose material in Tank 33 and 34, report WSRC-TR-2002-00260 and the DSA require these two tanks to be sampled prior to transferring sludge slurry if the transfer is to be categorized as Low-Rem. DOE reviewed calculations U-CLC-G-00002 and X-CLC-G-00025 and report WSRC-TR-2002-00260 and found them to be conservative and to show sufficient margin such that sampling from tanks other than Tanks 33 and 34 was unnecessary. For example, calculation U-CLC-G-00002 ran several cases, including: assuming 1 wt% sludge carryover into the supernate and all the sludge in the worst tank (39H) was Pu-238; assuming the Pu-238 in supernate

was at its solubility limit and also 1 wt% sludge carryover in the supernate; and showed the worst case dose potential was only ~1.1E8 rem/gal. Likewise, calculation X-CLC-G-00025 shows that even the settled sludge in Type IV tanks, if transferable, would not challenge the Low-Rem limit of 2.0E+8 rem/gal.

Based on DOE reviews, the computer codes are adequately identified and described, and the methodologies used to estimate radiological or other hazardous material source terms are properly documented and consistent with guidelines approved by DOE in Reference B.14.

DSA section 3.4.1 also provides a discussion of the EGs used for onsite (co-located) and offsite consequence comparison and selection of safety class and safety significant controls. These EGs, given in WSRC Manual E7, Procedure 2.25, are consistent with those previously approved by DOE (References B.13 and B.14), and for offsite, consistent with the EG given in DOE-STD-3009-94. The consequences from the various CSTF accidents were appropriately compared to these EGs, and, where necessary, preventers and mitigators were considered and evaluated to ensure their effectiveness was adequate.

B.10 Criteria: DOE-STD-3009-94, para. 3.4.2, Design Basis Accidents

Each DBA, including natural phenomena hazards, is identified and facility and equipment response (emphasizing preventative or mitigative equipment) to the event is summarized. All parameters and phenomenological models used to derive the source term are defined; exposures and doses are derived and compared to the EGs; and safety class SSC and assumptions judged to require TSR coverage are identified.

Evaluation

General –
Twenty two events were considered design basis accidents per DOE-STD-3009-94, are labeled "DBAs" in DSA section 3.4, and fall into the following categories:

(1) Flammable Vapor Hazards
- a) Evaporator Pot Explosion
- b) Evaporator Cell Explosion
- c) Transfer Facility Explosion
- d) Transfer Line/Jacket Encasement Explosion
- e) Pump Pit and Pump Tank Explosion
- f) Waste Tank/Annulus Explosion

(2) Liquid Releases
- a) Evaporator Overflow, Leaks, and Spills
- b) Transfer Errors
- c) Waste Tank Wall Failure
- d) Waste Tank Siphon/Pumpout
- e) Transportation Accident

(3) Evaporator Overpressure

(4) Airborne Emissions
   a) Evaporator Cell and Transfer Facility Fire
   b) Aerosolization Events
   c) Waste/Pump Tank Overheating
   d) Chemical Release

(5) Natural Phenomenon Hazards
   a) Seismic
   b) Tornado/High Wind
   c) Wildland Fire

(6) Other
   a) 299H Events
   b) Loss of Offsite Power

As stated earlier, Tank 48 has several unique hazards relative to the existence of benzene. These are identified in Chapter 18 of the DSA and evaluated in Section II.F of this SER.

Assumptions regarding the state of SSCs, whether assumed to fail or to remain intact, and their potential contribution to airborne or liquid and ground pathway release were discussed for each scenario and were found to be appropriate. Those cases where SSCs were capable of preventing or mitigating release were included in the assumptions. Where applicable, documented facility design parameters, such as fill limit elevations, tank and containment volumes, and physical barriers, were used to determine facility responses. Human error and limitations on ability to respond were also factored into facility and equipment response to events, and conservatism was used in the input assumptions, frequency determinations, and source term analysis. See Table B.3 for DOE assessment of inputs and assumptions used in the unmitigated scenario development which, to some extent, were limited by SSCs which are not functionally classified SC/SS and/or based on operator actions assumed to take place based on indications available. These assumptions, parameters, responses, etc. were reviewed by DOE and found adequate.

Each scenario included (directly or by reference) all assumptions, parameters, and dispersion models that were used to derive the applicable source term, including assumptions on facility failure and contribution to inventory dispersion. Secondary events were evaluated as applicable. The source term development included discussions of models used to determine the contributions from various factors such as thermal stress, free-fall spills, aerodynamic entrainment/re-suspension, venting of pressurized liquid, and pool evaporation. Derivation of source terms and resulting doses assumed reasonably conservative maximum quantities available for release (Material at Risk). Generally, the releases were assumed to be immediately available for uptake. The guidance from DOE-HDBK-3010-94 was appropriately used for Damage Ratio, Airborne Release Fraction, Respirable Fraction, and Leak Path Factors.

Groundwater flow was calculated for both retarded flow and unretarded flow. For releases into the ground, reports WSRC-TR-94-0368, WSRC-TR-95-0242, and calculation S-CLC-G-00039, concluded it required years for the radioactive materials to migrate into the nearest

surface water streams. This amount of time was judged more than sufficient to allow for mitigative actions to prevent the released material from entering into any water system available for public consumption.

Table B.1 presents a summary of the DBA events insofar as event frequencies and unmitigated and mitigated radiological (except event 3.4.2.21, Chemical Release) consequences (offsite and onsite (co-located)). The focus of the SER assessments of each individual accident is to ensure the postulated events were adequately analyzed and the appropriate controls were identified to prevent/mitigate the event. This review also utilized the control selection hierarchy given in Manual E7, Procedure 2.25 (e.g., preventors preferred over mitigators, design features preferred over administrative controls, passive controls preferred over active controls, etc.). As shown in calculation S-CLC-G-00280, in all cases, except event 3.4.2.21 (Chemical Release), the radiological consequences bounded the chemical consequences with respect to comparison to EGs (i.e., less waste must be released to challenge the radiological EG than must be released to challenge the chemical EG; S-CLC-G-00280 shows by $\geq$ a factor of 2). Thus, the chemical consequences were not calculated for each individual event and are not reported in the DSA, and are not shown in the following table, except for event 3.4.2.21 (Chemical Release). DOE review of calculation S-CLC-G-00280 found this calculation to be conservative and appropriate, and its conclusion valid.

Safety class SSCs and assumptions requiring TSR controls were identified for each scenario where the unmitigated offsite consequences exceeded the EGs. Safety significant SSCs and assumptions requiring TSR controls were identified for each scenario where the unmitigated onsite consequences challenged the EGs, and to provide significant defense-in-depth for scenarios challenging the offsite and/or the onsite EGs. An additional level of control was applied to those energetic events whose potential consequences could challenge EGs. The selection of safety class and safety significant SSCs and assumptions was found to be appropriate and consistent with the control selection hierarchy given in DOE-STD-3009-94 (assuming adequate incorporation of the Condition of Approval in Section I.F of this SER).

Comparison of the controls selected within the Hanford Tank Farm Authorization Basis to the controls selected in the CSTF DSA was performed by DOE (Ref. B.11). The conclusion reached was that the CSTF selected controls were appropriate and consistent, and where inconsistencies existed, adequate rationale exists to justify the differences.

Several of the DBAs used an input of 15,000 gallons of spilled/leaked waste in the unmitigated accident progression (e.g., Transfer Error, Transfer Facility Explosion, Annulus Explosion, etc.). The bases to support the unmitigated accident input of 15,000 gallons were discussed previously in SER Section B.9. DOE review found this input to be reasonably conservative; however, concerns were raised as to whether using this input should classify the accidents as "derivative DBAs" versus "DBAs" per DOE-STD-3009-94. To address this concern, the Contractor performed additional analyses to determine whether spilling/leaking additional waste (in particular, bounding sludge slurry) would identify any additional controls. The results of these additional analyses were documented in the Beyond DBA section (3.4.3) of the DSA, which DOE evaluated below, and showed that no new controls were warranted.

Individual Design Basis Accident (DBA) Evaluations -
DOE evaluated the DBA's for adequacy to meet the criteria at the beginning of Section II.B.10 above. Vertical in-depth reviews were performed for selected accident scenarios, including their supporting calculations, analyses, control derivation and vulnerabilities. The results of the vertical review evaluations are summarized in Attachment II.B. Summaries of other more significant accidents are described below.

Waste Tank Explosion - This scenario (discussed in DSA section 3.4.2.11) considers a deflagrable concentration of hydrogen in the waste tank vapor space and internal equipment (slurry pump column being the bounding volume for internal equipment). The Waste Acceptance Criteria (WAC) controls the contribution of organics to LFL in a waste tank at less than or equal to 5%. Thus, hydrogen is the dominant contributor to LFL. The waste tank deflagration event was shown to have unacceptable consequences for any frequency bin and thus, required to be prevented. For a deflagration in the waste tank, controls were established based on the amount of time it takes to go from 25% to 100% LFL following a loss of ventilation as well as the activities being performed within the tank.

All waste tanks must have at least 7 days from 25% LFL to 100% LFL upon loss of ventilation (non-seismic). This time is calculated using a hydrogen generation rate methodology described in DSA sections 3.4.1.1.2 and 3.4.1.5.3 and evaluated above.

The Flammability Control program categorizes the waste tanks as follows:

1. rapid generation tanks, with time to go from 25% LFL to 100% LFL less than 28 days, upon loss of ventilation
2. slow generation tanks, with time from 25% LFL to 100% LFL greater than or equal to 28 days, upon loss of ventilation
3. very slow generation tanks, will never reach 100% LFL, considering atmospheric breathing only

Waste tank ventilation is the primary SC control for rapid and slow generation tanks to maintain the flammable vapor concentration below 25%. A minimum flow rate of 72 cfm is required for rapid generation tanks and 45 cfm for slow generation tanks. These rates were established in calculations S-CLC-G-00258 and S-CLC-G-00288, respectively. This calculation also determined that, accounting for atmospheric breathing only, the waste tanks classified as very slow generation tanks will never reach 100% LFL and therefore do not require active ventilation. For waste tanks undergoing sludge mixing or salt dissolution in which the amount of flammable gas released could cause the vapor space to exceed 25% LFL, the waste tank ventilation system must be equipped with a control room alarm and interlock to stop sludge mixing or salt dissolution water supply. These additional requirements are not applicable on those tanks already under a Quiescent Time Program (i.e., 40, 42, and 51). These tanks have installed slurry pumps and the sludge transferred into these tanks is controlled (periodically agitated) such that the sludge is not allowed to retain sufficient trapped hydrogen to become a flammability concern.

Safety Class High Liquid Level Conductivity Probes (HLLCP) and their associated control room alarms are appropriately credited with protecting the assumed initial conditions associated with Type I/II/III/IIIA tank level. Type IV tank HLLCP's are considered safety significant due to the control on lower inhalation dose potential material in Type IV tanks.

Periodic LFL monitoring is the SS 2nd level of control for rapid and slow generation tanks not undergoing sludge mixing or salt dissolution. Monitoring provides an indication of the effectiveness of the SC ventilation system 1st level of control. Inherent in this strategy is that the vapor space of the waste tanks is well-mixed, even when ventilation is not operating. Technical Reports WSRC-RP-91-95 and WSRC-MS-92-054 both showed that, without ventilation running, hydrogen was sufficiently diffusive that the waste tank vapor space would be well mixed. DOE reviewed these and found this conclusion to be reasonable and appropriate. With the well-mixed vapor space, the hydrogen monitor would detect an increase in hydrogen concentration above 20% CLFL (10% indicated) which would cause operator action to reduce flammable vapor concentrations. The waste tank structure provides the mitigative SS 3rd level of control. The waste tank will provide some containment (not quantified), thus preventing some material from being released. By maintaining a minimum of 7 days to reach LFL, DOE concurs with the conclusion that sufficient time exists to detect the loss of ventilation flow, and restore ventilation or provide alternate ventilation. [Note that there are nine tanks (26, 27, 32, 33, 35, 39, 43, 44, and 49) which could reach LFL in less than 7 days post-seismic. This is evaluated below under the "Seismic" DBA.] Non-credited diesel generators are available as defense-in-depth to provide alternate power, if needed.

The control scheme for Very Slow Tanks is to set the HLLCP at or below a level such that the vapor space volume is sufficient to ensure the vapor space never reaches 100% LFL (by calculation) crediting atmospheric breathing as the only H_2 removal mechanism. Reports HLW-STE-2002-00247 documented that, even though the time to reach 100% LFL (T_{LFL}) in Tank 15 is 90-100 days, periodic measurements over years with no ventilation showed no increase in H_2 concentration. As concluded earlier in SER Section II.B.9, the hydrogen generation rates calculated have been shown conservative to the rates determined from actual measurements. Finally, as shown in SER Section II.B.9, the required opening size (0.1 in^2) to ensure adequate atmospheric breathing is very small compared to the available openings in a 0.75 to 1 million gallon waste tank with risers, ventilation system and other support system connections penetrating the tank top. Thus, DOE concludes there is sufficient margin to allow the Very Slow Tank category to use 100% LFL as the limit.

An additional requirement is imposed for waste tanks undergoing sludge slurrying/agitation, and which have the potential to exceed 25% LFL in the vapor space. Waste tank ventilation with flow indication and continuous LFL monitoring ensure the flammable gas concentration does not exceed 25%. A low ventilation flow or high LFL signal will interlock off the slurry pumps (except for Tanks 40, 42, and 51). In addition, the Pump Run Program will administratively control slurry pump operation to limit the amount of trapped and/or dissolved hydrogen released. For waste tanks undergoing salt dissolution, and which have the potential to exceed 25% LFL in the vapor space, waste tank ventilation with flow indication and continuous LFL monitoring are required to ensure the flammable gas concentration does not exceed 25%. The dissolution liquid source will be secured via interlock on low ventilation flow or high LFL signals.

The waste tank deflagration prevention strategy discussed above complies with NFPA-69.

Section 3.4.2.11 (Waste Tank Deflagration) also describes the results of hydrogen plume/pocket release studies and provides criteria to be used in determining the acceptability of

risk for Bulk Sludge Mixing (BSM) hydrogen releases. The criteria established for allowing BSM (the only identified planned activity which can release hydrogen at a sufficient rate to potentially cause a pocket/plume concern) protects the vapor space from exceeding a hydrogen concentration of 25% of the LFL. This BSM criteria ensures the assumptions made in the hydrogen plume/pocket release studies are not invalidated. Thus, no separate plume/pocket evaluation is necessary. If the hydrogen inventory in the waste tank exceeds the BSM criteria using the retention/release assumptions in DSA section 3.4.1.5, additional controls are required before authorizing BSM (e.g., slurry pump operating controls, ventilation low flow interlocks, high LFL interlocks, etc.).

DOE review of the controls in DSA section 3.4.2.11 found them to be adequate for preventing deflagrations in the waste tank primary vapor spaces.

Seismic - A seismic event (discussed in DSA section 3.4.2.18) is a potential initiator for other DBA events. This scenario considers releases during operations from all Tank Farms SSCs including: waste tanks, transfer systems (including pump tanks), evaporator vessels, HEPA filters, 299-H Maintenance Facility, cold feed chemicals, and stored solid wastes. The accident progression assumes the following are in progress: 2 sludge slurry transfers; 1 supernate transfer; 3 evaporators operating; 1 evaporator recycle transfer; and 1 canyon receipt. The analysis assumes all transfer prime movers are secured within 2 hours following the event. Airborne releases are assumed as a result of evaporation of surface releases, releases through tank top openings (riser plugs or other structures), and contents of ejected HEPA filters. All tank and evaporator ventilation system HEPA filters are conservatively assumed to be ejected, releasing the contents loaded on each. Assuming 20 HEPA filters are fully loaded and treated as a single source was judged to bound the case of having 200 HEPA filters partially loaded and spread out over the Tank Farm. Groundwater releases are possible due to failure of below-grade tanks, piping, etc. Stored solid wastes are assumed to be stored in B-25 boxes which, while not seismically qualified, are qualified to Department of Transportation standards and are, therefore, assumed to be adequate (even if these containers failed and released their contents, this would have a negligible impact on offsite dose consequences). Other facility and equipment responses to the event for the various SSCs are described below.

For an unmitigated PC-3 seismic event, the combined consequences of the various DBA's potentially initiated by a seismic event exceed the EGs. Thus, certain SSCs must be seismically qualified to ensure the seismic event does not lead to unacceptable consequences. However, the mitigated consequences reported for waste tank and pump tank explosions still exceed the EG's. The following functions were identified as needing controls:

1. To prevent deflagrations, ensure adequate time before 100% CLFL is reached in pump tanks and waste tanks such that waste can be removed or ventilation can be restored; qualify waste tank ventilation low flow interlock and alarm to stop sludge mixing and/or salt dissolution liquid supply; HLLCP's are required prior to the event to protect the waste tank level initial condition; tank quiescent and salt dissolution programs minimize the amount of trapped gas that could be released; pump tank passive vents (except for HPP-7 through –10) extend the time to LFL
2. To prevent surface releases, qualify transfer line core piping (including valves, jumpers, and connectors); secondary containment features (valve boxes, diversion boxes, pump pits, evaporator cells, etc.); secure transfers in progress immediately upon the seismic

event; and assess for/terminate any siphons occurring (from waste tank cooling coil failure or from transfers which were in progress)

3. To prevent an aerosolization event, the pump pit and diversion box sump steam jets are qualified; the pump pit and diversion box provide a mitigative confinement function; the waste tank steam/air lines and jets are qualified; the waste tank, annulus, and annulus jet /piping provide a mitigative confinement function
4. Limit the steam supply pressures to the evaporators via PCVs and PRVs. Also, manually secure steam supply and feed to the evaporators immediately upon the seismic event.

The likelihood of a seismic event being severe enough to cause rupture of above-ground transfer lines, yet not cause failure in the power distribution and/or steam supply systems onsite (which would stop the transfers, including feed to the evaporators, in progress), is very low. Similarly, the likelihood of a seismic event causing cracking/rupture of the tube bundles internal to the evaporators, yet not causing loss of the steam supply lines to the evaporators and/or the loss of evaporator pot integrity (especially 2F/2H which are not qualified), is very low.

In addition to the credited controls to prevent surface releases, a storm water system is in place to collect surface run-off and, if contaminated, divert to a retention basin. Finally, a Spill Contingency Plan exists which provides pre-determined actions at pre-determined locations to prevent surface releases from reaching the Savannah River. DOE concluded the risk of a scenario involving spilling/leaking waste and reaching the Savannah River is acceptably small.

The control rooms are not seismically qualified. The failure of the control rooms could affect the ability of the on-shift operations staff from responding to potential results from seismic event (e.g., flammable gas buildup, siphon of waste through chromate cooling water system, terminating transfers, etc.). However, it is judged that a seismic event which is severe enough to cause failure of the control rooms to the point where operator actions cannot be accomplished is likely to cause failure of steam supplies and electrical supplies such that the "credited" control room actions [(a) immediately securing transfers; (b) immediately securing steam supply and feed to the evaporators; and (c) immediately securing slurry pump/mixer operations] will be accomplished from the seismic event itself. Additionally, the DSA requires Seismic event response procedures to be in place to verify these actions are accomplished, so operators outside the control room will verify they occur.

With the actions above accomplished (either by control room operators or from the seismic event itself), the remaining actions necessary post-seismic (except restoration of ventilation for Tanks 27, 32, 43, and 44 – discussed below) are not required for at least 24 hours (restoration of pump tank ventilation, various inspections/monitoring). DOE concludes this affords sufficient time for the CSTF Staff to implement these actions.

Tanks 26, 27, 32, 33, 35, 39, 43, 44, and 49 can reach LFL in less than seven days (assuming no ventilation and including the effects of post seismic trapped gas release). Tanks 27, 32, 43, and 44 can reach LFL in less than 24 hours (assuming no ventilation and including the effects of post seismic trapped gas release). Especially for those tanks potentially reaching LFL in <24 hours, this risk was assessed and accepted by DOE based on:

1. the low likelihood of experiencing a major earthquake;
2. the expected conservatism in the assumed earthquake's ability to cause trapped gas to be released;
3. the DSA/TSR commitment to maintain sufficient portable ventilation units to respond quickly to re-establish ventilation on these tanks;
4. the fact that, should an explosion occur in one of these waste tanks, the material at risk would be the supernate, versus the much higher dose potential from sludge slurry; and
5. the ability of the Emergency Response Organization to ensure timely evacuation of onsite and offsite personnel from the plume pathway

Safety significant controls qualified for PC-2 earthquake loading are in place to prevent a siphon release onsite from the chromate cooling water system. However, an offsite dose from a PC-3 earthquake due to a siphon could be created if the cooling coils inside a waste tank failed or the siphon breaks on Tanks 29-35 cooling water header failed (both only qualified to PC-2 loading) and the cooling water header failed (e.g., at/near the cooling water pump house). The Seismic event offsite consequences include the contribution from a siphon scenario. This contribution, 12.1 rem offsite, would be obtained if all the sludge slurry in all the waste tanks were siphoned out onto the ground. Seismic event response procedures require operators to verify no siphon is occurring, but this could be delayed if severe control room damage occurred. However, the likelihood of having pipe failures in the necessary locations without also causing failures which would break the siphon is low. In order for a siphon of waste to occur, the following sequence would have to take place:

1. failure of the cooling coils inside the waste tank below the waste level, along with
2. failure of the cooling water header at a lower elevation are required, yet at the same time
3. failure in the cooling coils or header at a high elevation, or failure of the safety significant siphon breaks on Tanks 30, 33, and 35 to open, cannot occur

If all three of these steps did not occur, the siphon would be stopped due to creation of a natural vent. Thus, the 12.1 rem offsite dose contribution from cooling water system siphons is very conservative and would more than likely be zero, which further reduces the overall Seismic event risk from what is reported in the DSA.

Nearby Facility Impacts on CSTF -
Large hazardous material release from nearby facilities could potentially impact CSTF safety post-seismic by preventing restoration of waste tank ventilation on those tanks which could reach LFL in <24 hours or preventing restoration of pump tank ventilation.

The distance between CSTF and the Nuclear Materials Management Division (NMMD) and Defense Programs (DP) facilities (e.g., Tritium, H-Canyon, Receiving Basin for Offsite Fuels, etc.) were evaluated by DOE. It is judged that no credible mitigated accident in any of these facilities could prevent restoration of normal/backup purge and/or ventilation if necessary.

CSTF Impacts on Nearby Facilities -
As shown above, given the features and controls in place to protect the CSTF workers and the public, no impacts from CSTF onto nearby facilities will be created.

B.11 Criteria: DOE-STD-3009-94, para. 3.4.3, Beyond DBAs

Evaluate accidents beyond DBA to provide a perspective of the residual risk associated with the operation of the facility.

Evaluation

Beyond DBA accidents (discussed in DSA section 3.4.3) were analyzed using the graded approach to provide insight into the magnitude of consequences of Beyond DBAs. These Beyond DBAs include: Large Liquid Waste Release, Secondary Containment Explosions, Seismic (more severe than the Evaluation Basis Earthquake), Tornado/High Wind (wind speeds up to 200 mph) and Criticality.

Regarding the effects of leaking/spilling/overflowing > 15,000 gallons of sludge slurry, the evaluation provided in DSA section 3.4.3 shows that even spilling 100,000 gallons of 1.5E9 rem/gal sludge slurry (worst tank (Tank 39) only has an equivalent of 88,000 gallons of bounding sludge slurry) does not result in any new safety class controls. The worst offsite consequences using 100,000 gallons were:

a. Above-ground spill - < 3 rem
b. Transfer Facility Explosion - < 3 rem
c. Waste Tank Annulus Explosion - < 7 rem

Item "c" above does not include the additional consequences that would occur if the resulting explosion caused the waste tank primary wall to fail. This pressure loading was not analyzed. Thus, an explosion in the annulus must be prevented. The core piping traversing the annular space is SC and has a jacket surrounding this core pipe. Thus, leakage into the annulus from the core pipe during transfers is prevented. With this SC core pipe in place, the DBA analysis in DSA section 3.4.2.12 postulating a 15,000 gallon spill is adequate and very conservative.

In addition, since the transfer piping/jumpers is safety class, the only location where a spill/leak of any magnitude could occur is the potential overflow of a pump tank into the pump pit. However, the conductivity probes in pump pits are SS and required during any waste transfer through the pump tank/pit. Thus, the pump tank overflow would be detected and terminated well before even 15,000 gallons are spilled.

One other event, aerosolization due to internal seal failure in the air-operated diaphragm pump, could still occur even with the SC core piping since this air-operated pump is not SC. The DBA analysis of this event is given in DSA section 3.4.2.10 and also used 15,000 gallons as the amount of waste transferred through the pump assembly during the postulated seal failure. The resulting offsite dose was only 0.05 rem, so using 100,000 gallons would still only be <0.5 rem, well below SC concerns. The onsite dose would likewise go up if used greater than 15,000 gallons. However, the Transfer Control Program specifically requires material balances and transfer event monitoring to be conducted at a frequency to ensure ≤ 15,000 gallons of spillage/leakage would be detected and terminated. Thus, onsite dose calculated in DBA section 3.4.2.10 using 15,000 gallons is appropriate and adequate.

The scenarios and consequences were adequately developed to determine the frequency and risks. Other than the mitigative controls identified in section 3.4.3.1 for the Large Liquid Waste Release (i.e., stormwater system diversion and spill prevention and contingency plan) and in section 3.4.3.3 for the Evaporator Vessel Overpressurization (i.e., evaporator cell and

ventilation system confinement), controls developed from the DBA analyses in DSA section 3.4.2 were determined to be adequate. DOE review of these scenarios concluded this was reasonable.

Criticality - The criticality analyses and program were evaluated as part of the evaluation of DSA Chapter 6 (see SER Section II.E). The conclusion reached was that criticality safety was assured by virtue of the influent waste streams to the HLW storage tanks being sufficiently low in fissionable material concentration and containing abundant neutron poisons to prevent criticality for infinite geometry storage conditions, including within the unmixed, un-slurried sludge. Additionally, subcritical reactivity was assured under all anticipated (normal and credible abnormal) conditions to which the waste will be subject during storage and processing. No reliance on physical criticality controls was required. Additionally, these analyses concluded precise composition of fissionable materials and neutron poisons was not necessary because of the large ratios, or combinations of ratios, available between the neutron poisons and the fissionable material. DOE reviewed the Nuclear Criticality Safety Evaluations and Assessments (NCSEs and NCSAs) referenced in DSA Chapter 6 and concluded criticality was not a credible scenario under anticipated (normal and credible abnormal) conditions to which the waste will be subject during storage and processing. These NCSEs and NCSAs were found to be in accordance with DOE-STD-3007-93.

Additional assurance that criticality is not a credible concern is provided by the fact that additional neutron poisons exist in the sludge which are not credited (e.g., Zn, Cr, Ni, Hg, Na, etc.), and that areal density limits per ANS 8.1 are met on the macro scale (variability in unmixed tanks prevents crediting on micro scale). Certain assumptions, however, were identified which have to be protected in order to ensure the above conclusions remain valid. Additionally, certain prohibited activities were identified to ensure the appropriate evaluations are performed relative to criticality safety. These assumptions and prohibited activities are identified in DSA Chapter 6 and include:

1. Waste Acceptance Criteria program must ensure incoming waste streams to the Tank Farms are within the required neutron poison/fissile material ratios and alkaline conditions
2. Corrosion Control program must maintain waste chemistry within alkaline conditions
3. Oxalic acid cleaning of waste tanks is prohibited
4. Aluminum dissolution is prohibited

DSA Chapter 6 also committed to a sampling program during the planned salt removal process to confirm the expected abundant quantities of neutron poisons exist in the salt tank during waste removal.

Based on DOE reviews the Beyond DBAs were evaluated sufficiently to provide insight into their associated risks and the additional controls are appropriate.

B.12 References

B.1 Letter, Piccolo to Anderson, "Submittal of the Revised Safety Strategy for Preparation of the Consolidated CST Authorization Basis", HLW-2001-00164, 11/27/01

B.2 Letter, Anderson to Piccolo, "Safety Strategy for Preparation of the Consolidated Concentration, Storage, and Transfer Facility (CSTF) Safety Basis Documents to Meet 10CFR830", PC-02-012, 12/21/01

B.3 Calculation S-CLC-H-00858, Rev. 2, "Hazard Analysis for the CST Facility"

B.4 Memorandum, Gough to DBA File, 2/15/95, Software Quality Assurance & Software Management Report for MACCS Version 1.5.11.1, ECS-DBA-95-0040

B.5 Letter, Piccolo to Anderson, "Submittal of Concentration, Storage, and Transfer Facility Documented Safety Analysis and Technical Safety Requirements for DOE Approval," HLW-2002-00086, 6/27/02

B.6 Memo, Black (EH-53) to Argonne Group Manager, 8/12/98

B.7 Letter, Schwallie to Fiori, "Improvement in Safety Documentation," 12/1/93

B.8 Hertzberg and Cashdollar, "Flammability Behavior and Pressure Development of Hydrogen Mixtures in Containment Volumes," 2nd International Topical Meeting on Nuclear Reactor Thermal Hydraulics, Santa Barbara, CA, 1983

B.9 Zabetakis, "Safety With Cryogenic Fluids," Plenum Press, New York, 1967

B.10 Billy W. Marshall, Jr., "Hydrogen: Air: Steam Flammability Limits and Combustion Characteristics in the FITS Vessel," NUREG/CR-3468, SAND84-0383, Rev. 3, 12/86

B.11 Memorandum, Temple to Mikolanis, "CSTF 10CFR830 Documented Safety Analysis (DSA) Comparisons With Hanford and SRS H-Canyon," 12/17/02

B.12 WSRC-TR-2002-00285, Rev. 0, "CST DSA Defense-in-Depth Evaluation," November 2002

B.13 Letter, Fiori to Schwallie, 11/21/95, DWPF SER Rev. 0

B.14 Letter, Sjostrom to Oakland, 1/14/98, Authorization Basis Implementation Documents

B.15 Letter, Piccolo to Anderson, "Submittal of Changes to the Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements with DOE for Approval," HLW-2002-00164, 12/11/02

B.16 Letter, Widmayer to Temple, "Review of Engineering Calculations to Support DOE Review of the CSTF 10 CFR 830 Safety Basis Upgrades (Technical Support Services – RTP 46)," 8/28/02

Table B.1 – Unmitigated/Mitigated Accident Summary

DSA Section	Accident		Frequency	OEP (100m)		MOI	
				Unmitigated	Mitigated	Unmitigated	Mitigated
3.4.2.1	Evaporator Pot Explosion		A	40 R	40 R	< 0.1 R	< 0.1 R
3.4.2.2	Evaporator Cell Explosion		A	0.6 R	0.6 R	< 0.1 R	<0.1 R
3.4.2.3	Evaporator Overflow, Leaks, Spills		A	6.9 R	6.9 R	< 0.1 R	< 0.1 R
3.4.2.4	Evaporator Overpressure		A	50.2 R	50.2 R	< 0.1 R	< 0.1 R
3.4.2.5	Evaporator Cell and Transfer Facility Fire		A	4.4 R	4.4 R	< 0.1 R	< 0.1 R
3.4.2.6	Transfer Line and Transfer Line/Jacket Encasement Explosions		A	> 100 R	26.5 R	9.7 R	9.7 R
3.4.2.7	Transfer Facility Explosions		A	> 100 R	0 R	0.54 R	0.54 R
3.4.2.8	Pump Pit and Pump Tank Explosion		A	> 100 R	0 R	0.66 R	0.66 R
3.4.2.9	Transfer Error		A	> 100 R	15.4 R	0.43 R	0.43 R
3.4.2.10	Aerosolization Events		A	> 100 R	70 R	> 25 R	7.6 R
3.4.2.11	Waste Tank Explosion	I/II/III/ IIIA	A	> 100 R	0 R	> 25 R	0 R
		IV	A	> 100 R	0 R	1.1 R	1.1 R
		Slurry Pump	A	55 R	55 R	0.12 R	0.12 R
3.4.2.12	Waste Tank Annulus Explosion	Annulus	A	46 R	46 R	0.1 R	0.1 R
		Sump	A	< 1.0 R	< 1.0 R	< 0.1 R	< 0.1 R
3.4.2.13	Waste Tank/Pump Tank Overheating		A	47 R	47 R	< 0.1 R	< 0.1 R
3.4.2.14	Waste Tank Wall Failure		A	1 R	1 R	< 0.1 R	< 0.1 R
3.4.2.15	Waste Tank Siphon/Pump-out		A	> 100 R	0 R	12.1 R	12.1 R
3.4.2.16	299-H Events		A	59.7 R	59.7 R	0.1 R	0.1 R
3.4.2.17	Tornado and High Wind Events		T – U HW - A	> 100 R	35.4 R	> 25 R	0.13 R
3.4.2.18	Seismic		U	> 100 R	> 100 R	> 25 R	> 25 R
3.4.2.19	Wildland Fire		A	16.6 R	16.6 R	< 0.1 R	< 0.1 R
3.4.2.20	Loss of Offsite Power		A	> 100 R	0 R	> 25 R	0 R
3.4.2.21	Chemical Release		A	0.404 mg/m^3	0.404 mg/m^3	0.0012 mg/m^3	0.0012 mg/m^3
3.4.2.22	Transportation Accident		A	5 R	5 R	< 0.1 R	< 0.1 R

Table B.2 – Mitigated Accidents Reflecting Complete Control Set and/or DID

Section	Design Basis Accident	Uncredited Control(s)/Feature(s) which would reduce consequences	Doses (offsite/onsite) with "uncredited" control(s)/feature(s) in place
3.4.2.1	Evaporator Pot Explosion	Pot level corresponding to 40R would provide >> 10 days to remove the waste before reaching LFL. The pot level corresponding to 24 hours to reach LEL (where detonation could occur which is ~10x's higher consequence than a deflagration) upon loss of steam would be ~1/10 that associated with 40 rem (using data in DSA 3.4.2.18). Thus, the resulting consequences would be ~4 rem onsite. Within 24 hours, it is reasonable to restore steam to the tube bundle, air to the lance, etc.	<0.1R offsite ~4 rem onsite
3.4.2.4	Evaporator Overpressure	For this event by itself, neither EG challenged, thus no specific controls credited; however, the cumulative consequences from a seismic event drive the need to credit the tube bundle/lance steam supply PRVs and PCVs as SS controls.	<0.1R offsite 23.6R onsite
3.4.2.6	Transfer Line and Transfer Line Jacket/Encasement Explosions	The bounding offsite consequences are due to explosion in encasement. Core pipe is credited as SC for Seismic event. Crediting core pipe here would prevent encasement and jacket explosions. Also, the credited SS jacket/encasement hydrogen monitoring program prevents jacket/encasement explosions. Core pipe explosion would still be postulated to occur, but core pipe and jacket/encasement would tend to mitigate the consequence. Consequences per calc S-CLC-G-00234.	1R offsite (unmitigated) <0.1R offsite (mitigated – crediting flushing after sludge slurry transfers) 26.5R onsite
3.4.2.10	Aerosolization Events	The offsite dose of 7.6R is due to FPT-1 PTA sparging event. Accounting for the credited SS ventilation and 90% HEPA filter efficiency, the dose would reduce to ~6R (using calc S-CLC-G-00260). Accounting for the credited SS low FPT-1 level interlock and PTA air PRV, this event is prevented. The other non-prevented scenarios all have unmitigated offsite doses <0.5R. The two non-prevented large onsite dose scenarios are ADMP air column leak and the diaphragm pump aerosolization The ADMP air column leak consequence (70R) does not credit the ADMP column itself, which is designed to withstand the incoming air pressure (i.e., a passive design feature). The air column would prevent this scenario. Also, the 70R does not account for the credited ventilation/HEPA filter efficiency. Calc S-CLC-G-00260, section 7.3.2, shows the orifice and HEPA filter (90%) results in onsite dose of 15.6R (i.e., factor of 4 reduction). The diaphragm pump scenario would result in onsite dose of 52R, but again this does not credit the pump housing or any ventilation/HEPA filtration. Using results of calc S-CLC-G-00260, with a HEPA efficiency of 90%, doses would be reduced by a factor of 4 to ~13R.	<0.5R offsite <16R onsite

Table B.2 (continued)

Section	Design Basis Accident	Uncredited Control(s)/Feature(s) which would reduce consequences	Doses (offsite/onsite) with "uncredited" control(s)/feature(s) in place
3.4.2.12	Waste Tank Annulus Explosion	Onsite 46R is from explosion in annulus following core pipe leak. Core pipe is credited SC and pipe jacket is credited SS for Seismic event. Also, waste tank primary walls credited as SC for Seismic. Thus, this event is limited to non-seismic initiated tank leak rates (0.4 gpm), which does not reach LFL.	0R (prevented)
3.4.2.13	Waste Tank/Pump Tank Overheating	The onsite consequences are due to a steam jet supply line failing inside a Pump Tank. Steam jets are infrequently used in PTs, as the installed transfer pump is the normal motive force. The Aerosolization Event derives a control to lock out the PT steam jet when not in use and to verify the steam jet discharge is open prior to initiation. This prevents steam from discharging back into the PT waste and boiling the material. Additionally, the Aerosolization Event derives a control requiring active ventilation with HEPA during steam jetting in PTs. The next worst Overheating scenario is due to a waste tank steam jet supply line failure, but this is a credited SC control due to Seismic and the discharge path is also verified to be open prior to use. The next worst Overheating scenario is due to boiling of an evaporator drop tank for 8 hours. Consequences are from calc S-CLC-G-00257.	<0.1R offsite 7.5R onsite
3.4.2.15	Waste Tank Siphon/Pump -out	The offsite consequence of 12.1R assumes all sludge from both tank farms is released as a 16.7wt% slurry (423,000 gallons total) onto the ground. Overly conservative.	Conservatism of analysis supports doses being such that additional credited controls not needed
3.4.2.16	299-H Events	59.7R onsite dose based on explosion of WCT filled with maximum allowable sludge inventory to maintain Category 3 limit and at stoichiometric concentration, which requires >> 10 days to reach upon loss of ventilation. WCT has active ventilation (supplied by DG), is located well below ground in covered pit, and is periodically emptied.	0R [Realistically, WCT explosion is prevented by active ventilation system.]
3.4.2.17	Tornado/High Wind Events	Over half of the onsite consequence (26.5R) is due to postulated transfer line core pipe stoichiometric detonation (since lightning attributable to storm causing tornado/high winds). However, upon a tornado/high wind warning, employees shelter. Additionally, assuming the core pipe is at stoichiometric concentration when lightning strikes is very conservative. If core pipe was at LFL versus stoichiometric, this would reduce the explosion consequences by ~10.	<0.2R offsite ~12R onsite [35.4 – 26.5 + ~1/10*26.5]
3.4.2.18	Seismic Events	See DSA 3.4.2.18 and SER for discussion	

Table B.3 - Unmitigated Assumptions Regarding Operator Actions/Active Features Used in Defining Accident Progression

Scenario	Unmitigated Assumption Regarding Operator Actions and/or Active Features	Basis	Conclusion
Evap Pot Explosion	None		
Evaporator Cell Explosion	Max missing waste for large leak (2F/2H - 4875 gal; 3H - 8497 gal)	Equates to 4 hour lift rate; receipt tank periodically monitored. If feed line had large leak, pot level monitored and would detect even earlier. This input is bounded by the next values (36,803/32,861) which were used in the Cell Explosion DBA	Sufficiently conservative
	Max missing waste for small leak (leak rate not easily detected by material balances) (2F/2H - 36,803 gal; 3H - 32,861 gal)	Small leak could go unnoticed. Volumes shown equate to amount to overflow cell into cell ventilation ductwork and spill outside cell. Only a leak in the lift line of this volume could go undetected (leak in feed line leading to this volume would result in emptying the pot due to continue steaming with no feed). At the 20 gpm (2F/2H) and 35 gpm (3H) lift rates, the time to leak this volume is ~ 16-30 hours.	Sufficiently conservative
	Max missing waste post-seismic (2F/2H - 5100 gal; 3H - 14,647 gal)	Pot contents spilled + 1 hour of continued feeding	Seismic event initiates operator action to secure feed
	Spilled waste assumed unmitigated (i.e., not removed or ventilation not established) for 10 days	10 days is judged to be more than sufficient to mitigate the situation without any specific credited controls.	Sufficiently conservative
	The cell vapor space is assumed to be initially at 0% LFL	It is reasonably conservative to assume that the initial hydrogen concentration in the cell vapor space at the start of the event (i.e., loss of ventilation) is very small and can be neglected (assumed to be zero), based on the following. The evaporator cells are relatively large with high flow ventilation systems (approximately 2800 scfm for 242-25H, 800-900 scfm for 242-16F/242-16H). These ventilation systems are in operation whenever the evaporator is in operation. The hydrogen concentration with the ventilation operating would be essentially zero. If ventilation were to be shutdown for an extended period of time, hydrogen concentration (assuming a hydrogen generation rate of 9.6 E-06 ft^3/hr/gal @ 25 C, 5% contribution of organics) would take greater than 40 days to reach 25% of the LFL, even assuming the evaporator cell contains 11,250 (242-25H) or 5150 (242-16F/242-16H) gallons of waste.	Sufficiently conservative
Evaporator Overflow, Leaks, Spills	Max missing waste for large leak (2F/2H - 4875 gal; 3H - 8497 gal)	Equates to 4 hour lift rate; receipt tank periodically monitored. If feed line had large leak, pot level monitored and would detect even earlier.	Sufficiently conservative
	Max missing waste for small leak (leak rate not easily detected by material balances) (2F/2H - 36,803 gal; 3H - 32,861 gal)	Small leak could go unnoticed. However, leak rate such that volume spilled in 8 hour exposure time less than large leak case.	Sufficiently conservative
	Max missing waste post-seismic (2F/2H - 5100 gal; 3H - 14,647 gal)	Pot contents spilled + 1 hour of continued feeding	Seismic event initiates operator action to secure feed
	Non-waste overflow bounded by waste overflow and is not considered credible	• Evaporator operation deliberate and level constantly monitored and alarmed • Flushwater additions deliberate and done in batches, multiple batches required to overfill • Non-waste causing overflow would dilute waste in pot, so bounded by waste overflowing pot	Sufficiently conservative
Evaporator Over-pressure	Steam isolated to pot within 1 hour of tube bundle crack	The effects from a tube bundle crack (e.g., pressure increase, increased waste release, etc.) are detectable by pot pressure monitors, condenser vent temperature monitors, cell sump probe, cell sump dip tubes, increased overhead production, evaporator ARMs	Evaporator operation is deliberate and constantly monitored
	The minimum amount of liquid covering the 242-16F/242-16H/242-25H tube bundles is three inches.	The highest point of the uppermost tube of the evaporator tube bundles is normally covered by six inches of waste during normal operation. The tube bundle is of a bent tube configuration and therefore slopes downward. Therefore, the lowest point of the uppermost tube is covered by greater than six inches during normal operations (~10 in.). There are times during operation that the evaporator is operated at a lower level to suppress foaming. At these times the highest point of the uppermost tube is covered by approximately three inches of waste. Attempting to operate with a lower level than this could cause erratic operation and approaches the low level alarm/interlock (interlock on 25H only). For this reason, three inches is appropriate to use as a minimum value for the initial condition at the start of the accident (i.e., tube cracking).	Sufficiently conservative

Table B.3 – (continued)

Scenario	Unmitigated Assumption Regarding Operator Actions and/or Active Features	Basis	Conclusion
Evaporator Cell/Transfer Facility Fire	None		
Transfer Line/Jacket/ Encasement Explosion	Max missing waste – 15,000 gallons	Discussion in DSA section 3.4.1.5.2 provides adequate basis – key is Transfer Control Program requires material balances and transfer event monitoring to be conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected. Additionally, BDBA section revised to show that spilling more than 15,000 gallons does not result in identifying any new SC controls.	Sufficiently conservative
Transfer Facility Explosion	Max missing waste – 15,000 gallons	Discussion in DSA section 3.4.1.5.2 provides adequate basis – key is Transfer Control Program requires material balances and transfer event monitoring to be conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected. Additionally, BDBA section revised to show that spilling more than 15,000 gallons does not result in identifying any new SC controls.	Sufficiently conservative
	Spilled waste assumed unmitigated (i.e., not removed or ventilation not established) for 10 days	10 days is judged to be more than sufficient to mitigate the situation without any specific credited controls.	Sufficiently conservative
Pump Pit/Tank Explosion	Max missing waste – 15,000 gallons	Discussion in DSA section 3.4.1.5.2 provides adequate basis – key is Transfer Control Program requires material balances and transfer event monitoring to be conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected. Additionally, BDBA section revised to show that spilling more than 15,000 gallons does not result in identifying any new SC controls.	Sufficiently conservative
	Transfer continues for 2 hours after losing ventilation	Incoming transfer brings dissolved hydrogen. LFL/LEL already reached using 2 hours, consequences exceed onsite EGs (offsite dose only 0.66 rem), so increasing amount of dissolved hydrogen won't cause SC controls and won't change the need for SS controls. Additionally, TSR LCO requires transfer to be secured immediately upon loss of ventilation.	Covered
	Spilled waste assumed unmitigated (i.e., not removed or ventilation not established) for 10 days	10 days is judged to be more than sufficient to mitigate the situation without any specific credited controls.	Sufficiently conservative
Transfer Error	Max missing waste – 15,000 gallons	Discussion in DSA section 3.4.1.5.2 provides adequate basis – key is Transfer Control Program requires material balances and transfer event monitoring to be conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected. Additionally, BDBA section revised to show that spilling more than 15,000 gallons does not result in identifying any new SC controls.	Sufficiently conservative
	Max missing spray release – 1872 gallons	Based on 6 hours of spraying at 5.2 gpm. ARMs, dip tubes, CAMs, high dP on HEPA (from moisture buildup), material balances, would allow detection.	Sufficiently conservative
Aerosolization	Steam is isolated to jet in 1-2 hours after steam supply line to jet inside tank/box/pit fails or jet discharge path becomes blocked	No flow from jet for 1-2 hours detectable by level instruments in sending/receiving tanks. IF design basis case occurs, high dP due to moisture buildup on HEPA filters would occur, ARMs would alarm, dip tubes and/or conductivity probes in secondary containment locations with steam jets would alarm, CAMs on ventilation exhaust would alarm. Ignoring all these indicators is incredible. Additionally, steam jet aerosolization events exceed offsite EG using 1-2 hours, and one SC and one SS control identified. Exceptions are Type IV tank jet event (<0.4R offsite, >EG onsite), and Type I/II/III/IIIA tank annulus jet event (<5R offsite, >EG onsite) where two SS controls identified. Given these doses and the fact that selected controls were identified, no reason to change 1-2 hour assumption.	Sufficiently conservative

Table B.3 – (continued)

Scenario	Unmitigated Assumption Regarding Operator Actions and/or Active Features	Basis	Conclusion
Aerosolization	Amount of waste subject to aerosolization/sparging from air diaphragm pump is 15,000 gallons	Pump is analyzed as outside any confinement being used to transfer sludge slurry, where diaphragm fails and causes sparging/aerosolization to occur, causing significant airborne activity. The MAR is limited to 15,000 gallons. Transfer Control Program requires material balances and transfer event monitoring to be conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected. Additionally, multiple ARMs would alarm along with the fact that diaphragm failure would result in failure of waste getting to intended destination.	Sufficiently conservative
Waste Tank Explosion	Although not an unmitigated assumption, the HLLCP setpoint and associated TSR structure is, in part, based on max missing waste of 15,000 gallons to protect tank categorization (Rapid, Slow, Very Slow)	Discussion in DSA section 3.4.1.5.2 provides adequate basis – key is Transfer Control Program requires material balances and transfer event monitoring to be conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected.	Sufficiently conservative
Waste Tank Annulus Explosion	Transfer line through annulus leaks, spilling 15,000 gallons	Discussion in DSA section 3.4.1.5.2 provides adequate basis – key is Transfer Control Program requires material balances and transfer event monitoring to be conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected. Additionally, BDBA section revised to show that spilling more than 15,000 gallons does not result in identifying any new SC controls. Finally, since the core pipe through the annulus is SC, has a jacket, and is open-ended into the waste tank where pumps discharge through annulus, large/fast leaks into the annulus are not credible.	Sufficiently conservative
	Primary tank leak detected by the time the volume reaches "residual" level in annulus (@ 0.4 gpm leak rate, takes ~3.5 days to reach this level in Type III/IIIA tanks and ~14 days to reach this level in Type I/II tanks)	Detection occurs from drop in primary tank being noticed, dip tubes in annulus, conductivity probes in annulus, and/or radioactivity on annulus ventilation exhaust CAMs. Condition of Approval in Section I.F will ensure a SS leak detection device is available and operable.	Sufficiently conservative
	Spilled waste assumed unmitigated (i.e., not removed or ventilation not established) for 10 days	10 days is judged to be more than sufficient to mitigate the situation without any specific credited controls.	Sufficiently conservative
	The concentration of flammable vapors that accumulate in the underliner/leak detection sump remains below LEL and results in a deflagration only.	To protect this assumed initial condition, the flammable vapor sampling program ensures that the underliner/leak detection sumps are sampled at least once per year and that actions are taken to remediate any high flammable conditions identified.	Covered
Waste Tank/Pump Tank Overheating	Steam is isolated to jet in 1-2 hours after steam supply line to jet inside tank/box/pit fails or jet discharge path becomes blocked	No flow from jet for 1-2 hours detectable by level instruments in sending/receiving tanks. IF design basis case occurs, high dP due to moisture buildup on HEPA filters would occur, ARMs would alarm, dip tubes and/or conductivity probes in secondary containment locations with steam jets would alarm, CAMs on ventilation exhaust would alarm. Ignoring all these indicators is incredible. Additionally, the SC/SS controls identified from Aerosolization Event provide adequate prevention/mitigation of this event (Aerosolization more severe and controls address same initiators).	Sufficiently conservative
	Continued slurry pump operation to the point of boiling waste tank contents judged incredible	Slurry pump operation is planned activity and observed temperature increases during slurry pump operation have been ~2-3°C per day. Slurry pump operation is conducted with cooling water supplied to the tank, ventilation running on the tank (primary and annulus), temperature monitoring of tank contents, etc. with attendant indications available should these systems fail. Thus, postulating all these fail for a planned activity such as this is judged incredible.	Sufficiently conservative
Waste Tank Wall Failure	None		
Waste Tank Siphon/Pump Out	None		
299-H Events	None		
Tornado/High Winds	None		

Table B.3 – (continued)

Scenario	Unmitigated Assumption Regarding Operator Actions and/or Active Features	Basis	Conclusion
Seismic	None	No unique challengeable assumptions for the unmitigated case. Unmitigated case exceeds offsite and onsite EGs, so SC SS controls required. Mitigated case has some of the same assumptions for the individual events above (e.g., steam to evaporator pot secured in 1 hour, waste spilled from pump tank overflow limited to 15,000 gallons, steam to transfer jets isolated in 1-2 hours, recovery from spilled waste occurs within 10 days, etc.). Since the seismic event itself acts as the "detector" to initiate actions, these assumptions/values are acceptable.	
Wildland Fire	None		
Loss of Offsite Power	None		
Chemical Releases	None		
Transportation	None		

Intentionally Blank

Attachment II.B – Vertical Slice Reviews

A. Evaporator Explosion (DBA 3.4.2.1)

This scenario assumes that Hydrogen concentration mixed with air in the evaporator vapor space at or above the Lower Flammability Level (LFL) will ignite and explode causing a deflagration or a detonation in the evaporator pot.

Chapter 2 section 2.4 "Facility Structure", Chapter 3, section 3.4.2.1 "Evaporator Explosion", Table 3.4-4 "Evaporator System Design and Operating Characteristics" and Table 3.4-5 "Rated Pressures for Evaporator Vessel Components" were reviewed against calculation S-CLC-G-00217 "Explosion in a High Level Waste Evaporator" and Input Deck calculation S-CLC-G-00235. The review indicated that the chapters are consistent with the inputs, assumptions, methods, and results used in both calculations.

Two unmitigated accidents (evaporator startup and evaporator shutdown) were analyzed in Chapter 3. Five different scenarios were defined for the two accidents.

Two scenarios were defined for the evaporator startup accident. The scenarios assume rapid heating of the evaporator waste up to 100 degrees Celsius, instantaneously releasing all dissolved hydrogen/organics from the waste. The difference between the scenarios is the amount of waste in the evaporator pot during startup activities: one scenario assumes a partial fill volume and one scenario assumes a maximum fill volume.

The general startup accident progression for the evaporator startup scenarios assumes that the evaporator is being started and the evaporator vapor space is initially at 0% LFL. The evaporator pot temperature is rapidly increased to 100 degrees Celsius. Steam and air are lost with waste in the evaporator, and all of the dissolved hydrogen/organics from the waste is instantaneously released (due to a decrease in solubility of the dissolved gases). If an ignition source is present, an explosion could occur (if flammable vapors reached explosive levels). The explosion causes the evaporator pot to fail, either damaging the HEPA filters or creating other paths in the evaporator cell. Airborne material then escapes from the cell reaching onsite and offsite receptors.

Three scenarios were defined for the shutdown accident. Each scenario assumed an initial normal operating temperature of 186 degrees Celsius (3H evaporator) and 160 degrees Celsius (2H/2F evaporators). Two scenarios then assumed no temperature decrease in the evaporator pot, while one scenario assumed a temperature decrease to 100 degrees Celsius. In addition, two of the scenarios assumed that the evaporator feed pump continued transferring waste until a maximum level is reached in the evaporators. All of the dissolved hydrogen contained in the additional waste is instantaneously released. One of the scenarios assumed that the feed pump is secured shortly after steam and air is lost. In this case no dissolved hydrogen/organics are released due to no new waste transferred into the evaporator.

The general shutdown accident progression for the evaporator shutdown scenarios assumes that the evaporator is operating and the vapor space is initially at 0% LFL. During the operations, steam and air are lost. The evaporator feed pump continues to run until a maximum operating level is reached in the evaporator pot. All of the dissolved hydrogen/organics contained in the additional waste is instantaneously released. If an ignition source is present an explosion could occur (if flammable vapors reached explosive levels). The explosion causes the evaporator pot to fail, either damaging the HEPA filters or creating other paths in the evaporator cell. Airborne material will escape from the cell reaching onsite and offsite receptors.

The input and assumption sections of calculation S-CLC-G-00217, "Explosion in a High Level Waste Evaporator," were reviewed and found to be conservative, acceptable, and consistent with the Input Deck alculation S-CLC-G-00235.

The following key input and assumption were deemed worthy of mention for the evaporator explosion event.

- Material at Risk (MAR) of evaporator bottoms and the assumed/protected 1 wt% sludge carryover
- 10 days to respond to loss of steam/air (removing waste, restoring steam and/or air, etc)

A series of controls have been developed to protect the safety analysis value of 1 wt% sludge carryover. These controls are implemented under the Technical Safety Requirements administrative controls program. One of these controls is to maintain 24 inches separation between the pump/jet suction and the sludge layer. While evaporator bottoms concentration might increase due to the evaporation process, the evaporator feed pumps have smaller zone of influence than jets which results in less solids carryover in the feed system. Evaporator pot camera inspections have been performed and have shown no evidence of sludge carryover into the evaporator vessel. The 24 inches separation is conservative, and the controls established to protect the safety analysis value are reasonable.

The 10 day response time assumed in the calculations is very conservative. The H and F Tank Farms evaporators are 24 hour/day operating facilities. Facility operators undergo a rigorous qualification program which includes training in facility emergencies. A conduct of operations program has been implemented in the Tank Farms, which has established facility requirements to effectively operate the Tank Farm evaporators. Facility monitoring is effectively achieved by operator awareness of facility conditions (evaporators). In the event of losing air/steam to the evaporator (event initiator), alarms will be received in the applicable central control rooms. Operator actions will take place in minutes to hours, not days to mitigate the event.

The assumption section of the calculations indicated that an ignition in an evaporator is assumed to occur either at 10 days or at stoichiometric conditions (time independent). The 10 days hydrogen buildup in the evaporator vessel could lead to an evaporator explosion (deflagration). The 10-day period assumes that no operator actions take place, thus allowing flammable vapors to reach explosive levels. If a deflagration would occur, calculations indicated that the vessel itself would withstand the impact.

The scenarios were also evaluated at stoichiometric conditions. Calculations indicated that it will take between 61 to 296 days (depending on the scenario) to reach a hydrogen concentration in which a detonation would occur. The assumptions are based on no operator actions, allowing flammable vapors to reach explosives levels in the evaporator vapor space.

The bounding unmitigated consequences for the loss of steam/air resulting in an explosion (detonation) in the 3H, 2H, and 2F evaporators were calculated assuming a partial fill volume in the 3H (6,500 gallons) and 2H/2F (1000 gallons) evaporators and assuming the vapor space was at a stoichiometric H_2 concentration. Calculations indicated that the bounding case for the three evaporators is the partial fill scenario for the 3H evaporator (since this resulted in the largest vapor space, equating to the most combustible gas, equating to the largest amount of energy, causing the most amount of vaporized waste). This bounding scenario also involves the failure of the lower vessel due to the resulting detonation

pressure, thus the pot contents are released into the cell, undergoing spilling, splashing, and subsequent aerodynamic entrainment of the contents pooled at the bottom of the cell. The bounding event unmitigated consequences are 40.0 rem onsite and 0.0649 rem offsite. Calculations showed that it would take 296 days for the flammable vapors to reach the explosive levels in the evaporator corresponding to these consequences. The consequences of an evaporator explosion are well below the offsite release limit of 25 rem addressed in DOE-STD-3009-94 and below the onsite release limit of 100 rem addressed in the Manual E7, procedure 2.25.

The bounding evaporator explosion accident described above is not a realistic event. The most likely accident is the evaporator shutdown with the loss of steam/air at maximum fill. If feed is secured upon loss of steam/air, the pot vapor space would not reach LFL in at least 10 days, so a deflagration would be prevented. If feed continued for a sufficient period of time, LFL (or even LEL if continued longer) could be reached in the vapor space, but the vapor space volume would be much less than the volume assumed in the bounding partial fill case described above. Thus, although the evaporator shutdown at maximum fill is a more realistic accident, the onsite/offsite consequences would be much lower than the bounding accident described above. DOE concurs that no mitigated analyses are needed for the evaporator explosion accident.

B. Evaporator Over-pressurization (DBA 3.4.2.4)

As part of DOE's vertical slice assessment of accident scenarios, calculation S-CLC-G-00281, "2F/2H/3H Steam Tube Leak Before Break Accident" was reviewed. This calculation supports the Design Basis Accident for evaporator overpressurization. DOE reviewed and validated the inputs and assumptions that formed the basis for the calculation. These inputs were discussed in a previous calculation, S-CLC-G-00235 Rev. 2 "Input and Assumptions for the Concentration, Storage, and Transfer Facilities". All input values were verified by reviewing reference documentation such as vendor and design drawings or through other independent means.

Several of the inputs and assumptions used to evaluate the overpressurization event were thoroughly evaluated due to their importance in the accident analysis. The more significant inputs and assumptions are discussed below in more detail.

Orifice Erosion

DOE reviewed the basis for orifice diameters for both the evaporator lance and steam tube bundles. Engineering analysis showed that very slight increases in the orifice sizes could be expected between inspections. Based on past operating experience (biannual orifice inspections), little to no erosion has been observed on either the steam or air orifice. DOE considers the assumed correction factor or growth for the 2F, 2H, and 3H evaporator steam orifices and air orifices appropriate. Differences in the assumed correction factors for air and steam were investigated and determined to be based on conservatism in the air orifice erosion rate. Based on DOE review of existing data, the values assumed for orifice diameters to support the DBA are acceptable.

Steam Lance Pressure

The assumed mitigated steam pressure to the evaporator lance is 170 psig versus a source of 150 psig and an assumed tube bundle pressure of 150 psig. Operational experience has shown that line loss to the tube bundle (from the same source) will be greater than to the lance. In addition, tube bundle pressure will not be greater than 150 psig given the pressure relief and control valves are set at 150 psig (credited in the seismic event). The input value, 170 psig for the steam lance pressure, assumes upward drift of relief valves with added conservatism. DOE has determined that the assumed values for lance pressure is reasonably conservative for the DBA analysis.

Tube Bundle Pressure Limits

During the course of the review it was noted that the 2F and 2H tube bundles were rated for 171 psig. However, consequence calculation indicates that the pressure will go up to 370 psig without failure. No discussion or reference initially existed to show that the tube and tube bundle could withstand the high pressure expected in the unmitigated scenario. To address this concern, a structural evaluation of the tube bundle to withstand the pressures assumed was initiated. A structural analysis report issued in August 2002 indicates that the tube and tube bundle can withstand the pressures used in the calculation. DOE reviewed the memorandum from the Structural Mechanics Section (PEC-EAT-02-0020) and is satisfied with the results indicated. A reference to this memorandum has been added to the DSA.

Assumed Pinhole Size

The tube bundle is assumed to have a preexisting hole at the initiation of the DBA. The assumed pinhole size was based on NUREG 0800 and flaw stability evaluations from Structural Mechanics (calculation T-CLC-H-00617). The piping, including the tube bundle, associated with the High Level Waste (HLW) evaporator is designed per ASTM B&P Vessel Code, Section VIII, Division 1 (Drawing BPF212560,

Sheet 47). Methodology for the flaw stability analysis (T-CLC-H-00617) is per American Petroleum Institute (API) code API-579, Fitness-For-Service. Section 1.2.2 of API-579 allows application of this methodology since the code of record for the design of the evaporator and associated piping was ASTM B&P Vessel Code, Section VIII, Division 1. Section 5.0 of T-CLC-H-00617, Methodology, states that Flaw stability is evaluated using API-579 Level II FAD analysis without stating any assumption(s) and/or basis for that methodology. One of the limitations to use this methodology is to ensure no crack growth is expected. Section 3.4.2.4.3 of the DSA states the rate of crack growth may be as much as 10%. In calculation T-CLC-H-00617 crack growth at the end of each load cycle is manually computed using the resulting stress intensities at the crack and then applying crack growth laws. API-579 Methodology level III allows this approach and hence DOE accepts this approach for analysis.

The sources of material properties, ASTM 304L (Tube bundle for evaporator 2F) and ASTM G30 Hastelloy (Tube bundles for evaporators 2H and 3H) are described in Section 6.0 of calculation T-CLC-H-00617. Section properties are described in Section 4.0. For the 3H Evaporator, a minimum thickness of 0.083" is taken for a nominal thickness of 0.1455" applying an allowance for corrosion. Neither of the materials ASTM 304L or ASTM G30 is corrosion prone in the controlled chemistry environment that the evaporators have. However, since historically for the 3H evaporator analysis was performed using both maximum and minimum thickness, calculation T-CLC-H-00617 maintained the same methodology and performed the analysis for two different thickness values. DOE review of the references listed in T-CLC-H-00617 show the values are adequate.

Load conditions are described in Section 4.2 of T-CLC-H-00617. Loads and load combinations are taken as recommended by API 579, Appendix A. Load sources are identified. Pressure cycles are the governing cycles compared to thermal cycles. The number of pressure cycles used in the analysis was conservatively estimated based on the past operations experience (e.g., 300 steam pressure cycles on the tubes per year). Through discussions with Operations personnel, DOE determined the cycles used in the analysis were adequate and conservative (e.g., the 300 steam pressure cycles, which normally involves a slow ramp up in pressure, were assumed to be applied the same as the very quick desalt/descale pressure cycle).

Fracture analysis is performed using a computer program ANSYS. The program has been verified per Section 5.0, Software Engineering and Control, Manual E7, Conduct of Engineering and Technical Support. The conclusion from the analysis results is properly and adequately documented in section 3.4.2.4 of the DSA.

The evaluation in T-CLC-H-00617 showed that the hole is stable and did not grow to the point of complete tube rupture. However, for conservatism, the flaw length was assumed to be equal to that of tube instability (0.6 inches). The flaw width was assumed to be equal to 0.5 times the tube thickness. The crack size assumed for 2F and 2H is 0.6 inches by 0.0415 inches and for 3H the crack size is 0.6 inches by 0.0728 inches. These areas were converted to circular areas for the accident analysis which is consistent with pit corrosion. Pit corrosion has been identified as the dominant failure mechanism for the tube bundles. Analysis of pinholes formed by pit corrosion show that circular holes formed will be smaller in diameter than those assumed in the DBA and will not grow larger than the assumed hole between tube bundle integrity checks. Analysis has also shown that holes as small as 0.01 inches in diameter can be detected during the biannual hydrotest.

Based on the above evaluation, DOE is satisfied that adequate assumptions have been made relative to the assumed pinhole size.

Tube Bundle Leak Aerosolization

DOE reviewed the potential for the assumed tube bundle leak to jet evaporator pot contents leading to a larger source term. In the calculation, all leaks are assumed to break up into bubbles before reaching the op of the liquid/air interface (i.e., not be "jetted" out into the pot vapor space). Referenced documentation indicates that 3-4 inches of liquid above the leak site is needed to prevent "jetting". The break up of all leaks to bubbles has been determined to be reasonably conservative based on normal evaporator operating waste levels and the physical configuration of the tube bundles.

Assumed Maximum Air Temperature in Demister

DOE reviewed the potential for re-entrainment of evaporator pot contents in the demister. Re-entrainment is assumed to occur in the 2F evaporator leading to the highest consequence of the three evaporator overpressurization events. The assumed maximum air temperature in the demister used for calculating re-entrainment potential was 105 degrees F. It was noted that re-entrainment potential is sensitive to the assumed temperature. Additional analysis was performed at 2H and 3H at 160 degrees F and it was determined that no significant increase in the re-entrainment velocity was observed. The results for the 2H and 3H evaporator remained the same – no re-entrainment. DOE is satisfied that re-entrainment is appropriately characterized for each evaporator system.

Operator Action for Steam and Air Isolation

Several operator actions are credited as part of the evaporator overpressurization event to limit the consequences. The DSA credits operator action with isolating steam to the tube bundles and lance within 1 hour of event initiation. It is also assumed that air to the lance will be isolated within 8 hours of event initiation. DOE reviewed all credited operator actions and determined that sufficient indications exist to allow the operator to detect the event, and adequate time has been allowed for steam and air isolation. The total of 8 hours for steam and air isolation is consistent with the assumed event duration for offsite exposure in DOE-STD-3009-94.

The results of the calculation show that the consequence from evaporator overpressurzation following a seismic event is as follows:

Evaporator	Offsite Dose	Onsite Dose (100m)
2F	91.1 mrem	50.2 rem
2H	23.2 mrem	17.9 rem
3H	53.2 mrem	37.5 rem

Based on DOE review, the results of the calculation are reasonably conservative and form an acceptable basis for the Design Basis Accident – Evaporator Overpressurization.

DOE Review of DSA Chapters 2, 3, 4, and 5

DOE conducted a review of relevant sections of the DSA associated with the evaporator overpressurization event. Each section was reviewed for accuracy of technical information, consistency among the various sections and chapters, and completeness of information presented. Each chapter below was reviewed as the DSA relates to the evaporator overpressurization event. Additional reviews and discussion of each chapter can be found in other sections of this Safety Evaluation Report.

DOE reviewed Chapter 2, "Facility Description", sections 2.4.2, "242-16F/16H Evaporators" and 2.4.3, "242-25H Evaporator" for accuracy of the information presented in describing the evaporators. Adequate detail was provided for each evaporator such as evaporator systems, layout and dimensions, and material

of construction. Several items of description were checked against the inputs and assumptions from the consequence calculation (S-CLC-G-00281), and no discrepancies were identified.

Included in the review of Chapter 3 was calculation S-CLC-H-00858 which identified potential mechanisms to initiate the evaporator overpressurization event. All the events were found to be bounded by evaporator overpressurization following a seismic event. Additional events were analyzed and found to be low risk or were dropped from consideration because of the design or configuration of the facility. DOE evaluated the list of initiating events and is satisfied that the seismic initiated event was appropriate to be carried forward for detailed analysis. The calculated consequence was highest for the 2F evaporator at 50.2 rem onsite and 91.1 mrem offsite. The 2F consequence was highest because of re-entrainment potential at that facility. Re-entrainment is not supported in the 2H or 3H evaporators (S-CLC-G-00281).

DOE verified the accident progression and source term analysis was consistent with the consequence calculation (S-CLC-G-00281) and other DSA chapters. Appropriate key assumptions and inputs from the calculation were incorporated into Chapter 3 and the tables accurately reflected the results. The unmitigated consequences were below EGs for both the site worker (50.2 rem) and the maximally exposed offsite individual (91.1 mrem). No safety class controls are required. Two components have been identified as safety significant to maintain the initial conditions of the assumed accident. These are the lance steam and air orifices which limit flow of steam and air following a seismic event and the steam tube bundles which must maintain their integrity (given a small hole). Corrosion control and structural integrity programs are also credited to maintain the functionality of the safety related components.

The evaporator overpressurization event is also included in the area-wide seismic event (section 3.4.2.18). In this scenario, the steam pressure control and relief valves (PCRV) for the lance and tube bundle are credited as safety significant equipment. Because the PCRV are credited as functioning only in the area-wide seismic event and not in the overpressurization event, the consequences of the evaporator overpressurization in section 3.4.2.4 is conservatively high.

DOE reviewed Chapter 4 to ensure consistency with requirements, other DSA chapters, and that the identified controls were adequately described. No discrepancies were found.

DOE reviewed Chapter 5 to ensure consistency with requirements, other DSA chapters, and the TSR for the evaporator overpressurization event. No discrepancies were found. Additional Chapter 5 discussion and review comments are discussed in other sections of this Safety Evaluation Report.

C. Pump Tank Explosion (DBA 3.4.2.8)

DOE performed an independent review of the Pump Tank Explosion Design Basis Accident (DBA) scenario, section 3.4.2.8 in the DSA. The review consisted of a detailed review of the DSA/TSR with supporting references for one process area (FPT-3) and a general review of key assumptions for applications to other process areas.

DOE review of the CSTF Hazard Analysis (HA) (S-CLC-H-00858, Rev. 2) concluded that credible initiators to a pump pit and pump tank explosion were correctly documented and assessed. Examples of postulated causes include an inadvertent transfer of organic waste, an inadvertent transfer of sludge, a loss of ventilation, a buildup of hydrogen from residual waste, and transfer line jumper leaks. DOE's review did not identify any explosion initiators other than those postulated in the HA.

The analyzed event starts with a flammable gas (hydrogen/organic vapor) build up in the pump pit/tank due to a loss of ventilation with an unspecified ignition source resulting in an explosion and breach of the pump tank and transfer line during a transfer. Consequence of the transfer line break was assessed separately from the pump tank explosion. The ignition source was always assumed to be present. Material at risk was stated to be the pump tank volume with residual waste in the pump pit as appropriate to the scenario. Many of the postulated scenarios resulted in accidents that were qualitatively judged to produce high radiological doses from unmitigated exposure both on-site and off-site.

The results of the qualitative approach used in the HA required a quantitative analysis to be performed in calculation "Explosion in a Transfer Facility or Evaporator Cell" (S-CLC-G-00209, Rev 0). DOE performed a detailed review of this calculation including verification of the key input values, the applicability of the technical approach and assumptions, and independent performance of the computations to verify results. The calculation determined the time to lower flammability limit (LFL) for scenarios consistent with the HA, the onsite and offsite dose consequences from a postulated unmitigated explosion in a transfer facility or evaporator cell, and the required ventilation flow rate to prevent reaching LFL.

Key inputs were verified:

1. F-Pump Pit 3 (FPP3) volume (M-CLC-G-00283, Rev. 2). The volume of the pump tank was subtracted from the volume of the pump pit for calculating pump pit ventilation and approach to LFL.
2. Residual waste volumes for pump pits to remain below 25% CLFL for bounding hydrogen generation rate (S-CLC-G-00272, rev 0). This calculation determined that for FPT-3, maintaining residual sludge volume at less than 1.29% of the PP volume would ensure that the vapor space would be maintained less than 25% of the LFL.
3. Physical properties of sludge and supernate were bounded but controls were not applied to these individual property values. Controls were applied instead to the inhalation dose potential per gallon of sludge (1.5E+09 rem/gal) and supernate (9.8E+07 rem/gal). The inhalation dose potential values are protected by the Waste Acceptance Criteria Program (Administrative Control, AC 5.8.2.15) and the Waste Tank Inhalation Dose Potential Program (AC 5.8.2.51)
4. Hydrogen generation rate for sludge slurry and supernate. The generation rate depends on radiolytic heat load and the scavenging effects of nitrate and nitrite (combined to NO_{eff}). The value for NO_{eff} is not a controlled value in any of the hydrogen generation inputs. The NO_{eff} was chosen to use for a comparison to current Tank Farm conditions and to choose a reasonably conservative hydrogen generation rate. The hydrogen generation rate is the

controlled value in the Waste Acceptance Criteria Program (AC 5.8.2.15) and the Hydrogen Generation Rate Control Program (AC 5.8.2.32)

5. The organic contribution to CLFL (S-CLC-G-00270, Rev 3). The calculation considers 5% organic contribution to CLFL for all evaporated organic canyon waste streams. Without evaporation, each transfer must undergo an engineering evaluation. This calculation also considers the potential organic contribution to CLFL for a Process Vessel Vent system flush to show the impact to CLFL for a high organic waste stream. The organic contribution to CLFL is therefore considered and bounded in the approach to CLFL. Organic concentrations, heat generation rate, hydrogen generation rate and flammable vapor concentrations during waste transfers are controlled by the Waste Acceptance Criteria Program (AC 5.8.2.15), Waste Tank Inhalation Dose Potential Program (AC 5.8.2.51), and the Hydrogen Generation Rate Control Program (AC 5.8.2.32).
6. Composition of the trapped hydrogen bubbles formed by radiolysis (WSRC-TR-2001-00193, Rev 3). The expressions in this report correlate hydrogen composition of gas formed by Cobalt-60 and alpha and beta/gamma radiolysis in nitrate and nitrite solutions. Expressions were validated against known solutions.
7. Leak Path Factor (LPF) of 1 assumes integrity of the cell is lost due to the explosion (unmitigated case). This is a reasonable assumption because of the difficulty in estimating impingement on the cell surfaces during the explosion.
8. Airborne Release Fraction stated to be 10% (ARF=0.1). The calculation recognizes that this is a conservative value based on the formation of explosive gases above the liquid level. Gases will entrain liquid droplets by passing over the liquid surface. This interaction will cause less entrainment than gases passing through a liquid.
9. Event duration - Operations events are expected to take on the order of 2-3 days with time for troubleshooting and repairing equipment or replacing damaged equipment. The duration was adjusted to 10 days to reflect the size of a significant event and the need for outside support.

The key assumptions were reviewed by DOE and determined to be appropriate, conservative, and consistent with facility configuration. Additionally, these key inputs were compared to the CSTF DSA Input Deck (calculation S-CLC-G-00235) and found to be consistent.

This calculation determined that the vapor space for both F Pump Pit 3 and F Pump Tank 3 would reach CLFL when forced ventilation was lost during a transfer of either sludge or supernate. The time to CLFL for the Pump Pit is much longer than the time to CLFL for the Pump Tank due to the larger Pump Pit volume and atmospheric breathing of the Pump Pit. Controls implemented to mitigate and prevent the Pump Tank explosion bound any event for the Pump Pit. The calculation determined that an explosion could occur in F Pump Tank 3 during loss of ventilation while transferring either sludge or supernate. The worst case consequence event is an explosion during a sludge transfer which results in an offsite dose (0.33 rem) well below the offsite EG of 25 rem, but an onsite dose (150 rem) above the EG of 100 rem. The worst case time to CLFL for F Pump Tank 3 was determined to be 21 minutes, from the time ventilation is lost, during a steam jetted transfer of supernate.

The DSA was reviewed to determine how the safety analysis was developed to provide protection from an explosion in a Pump Pit and Pump Tank. Section 2.4.4 provides an accurate description of the transfer facility. DSA Table 3.3-11 identifies HA events specific to a PP/PT explosion not requiring controls. DOE review of Table 3.3-11 found the justifications to be clear, specific, and appropriate. Table 3.3-14 "Transfer System Mitigated HA and SS Controls" was reviewed for consistency with the HA and the consequence documented in the explosion calculation. This review determined that the specified controls

were consistent with the selection hierarchy found in DOE-STD-3009-94. DOE's analysis of the controls is discussed later with the TSR controls. Section 3.4.1 develops the methods of analysis that are used in calculation "Explosion in a Transfer Facility or Evaporator Cell" (S-CLC-G-00209, Rev 0). No inconsistencies were noted between the explosion calculation and section 3.4.1.

DSA section 3.4.2.8 discusses Pump Pit and Pump Tank explosions. The pump pit/tank accident progression is consistent with the scenario used in the HA and explosion calculation. This section documents that three (3) safety significant controls were warranted per the guidance in Manual E7, Procedure 2.25. Two controls are required because the onsite EGs are exceeded, and an additional control is needed because the event involves an explosion. The first control is the PP/PT active ventilation system. The ventilation system provides minimum flow to prevent accumulation of flammable vapors. Backup ventilation is provided for certain pump tanks receiving jetted transfers from a source with greater than 1200 gallons. The second level of control is the PP containment. This containment mitigates the accident through impingement of material on the cell covers. The third level of control is the Event Response Program that will require personnel evacuation and event mitigation to minimize potential release. The consequence section documents that the exposure onsite and offsite is reduced to zero through prevention of the accident. The review of this section found no inconsistencies between the consequence calculation, the accident analysis and the safety significant control selection.

The Pump Pit Ventilation system is identified and evaluated in Chapter 4 to show it meets the safety significant criteria. DOE reviewed the criteria in section 4.4.9 and Table 4.4-2 and found the evaluation to be appropriate and sufficient to show the ventilation system consistent with SS level of control. Section 4.4.9 also contains a detailed description of the ventilation system including non-credited features that support the ability to monitor ventilation.

Ventilation flow rate and operability requirements for Pump Pit/Pump Tank ventilation are developed in Chapter 5, section 5.5.1.5, and documented in LCO 3.7.5. Actions taken upon a loss of ventilation, as documented in LCO 3.7.5, were judged to be correct. The Completion Time for stopping water addition (step A.1), stopping all waste transfers (step A.2) and stopping jetted transfers out of the sumps (step A.3) are supported by the requirement to verify ventilation exhaust flow every 10 minutes during a transfer (SR 4.7.5.1). Using personnel to verify ventilation flow is acceptable due to the supporting Administrative Control (Transfer Control Program, AC 5.8.2.21) and because the transfer will be a planned operation with the ability to stage personnel for a limited duration.

Calculation S-CLC-G-00209, DSA Chapters 3, 4, 5, and the TSRs were also reviewed for overall consistency with the inputs, approaches, and results for Transfer Facility Explosions in other locations (e.g., diversion boxes, valve boxes, etc.). This review found the calculation, DSA, and TSRs consistent and adequate. Additionally, for F Pump Pit 3 and F Pump Tank 3, as well as the other locations of concern, the controls selected followed the selection hierarchy found in DOE-STD-3009-94 (e.g., passive over active, prevention over mitigation).

Based on the above evaluation, DOE concluded that the Transfer Facility Explosion analyses were comprehensive, conservative, and fully adequate. Additionally, the controls derived were adequate to prevent and mitigate the scenarios of concern and followed the hierarchy of control selection found in DOE-STD-3009-94.

D. Transfer Error (DBA 3.4.2.9)

DOE performed an independent review of the Transfer Error Design Basis Accident (DBA) scenario, section 3.4.2.9 in the DSA. This independent review consisted of a detailed review regarding one particular process area (HDB-2) and a general review of key supporting documents.

DOE reviewed the CSTF HA (S-CLC-H-00858) and concluded that the types of credible initiators to a transfer error, which includes leaks/spills/overflows, were properly identified. Numerous credible initiators to this event were identified (pipe breaks/leaks from mechanical failure, corrosion, thermal damage, external events such as earthquakes and vehicle crashes). DOE did not identify any other transfer error initiators than those postulated in the HA.

The basic transfer error progressions are as follows:

1. Above-ground pipe breaks
   a. above-ground pipe breaks during transfer of waste (bounding case uses bounding sludge slurry material)
   b. waste spills onto ground until transfer terminated
   c. airborne release occurs due to free fall spill, splashing, and then outdoor aerodynamic entrainment from resulting pool due to wind effects

2. Pipe breaks (or Pump Tank overflows) inside a box/pit/waste tank/riser/etc.
   a. pipe breaks (or Pump Tank overflows) inside a box/pit/waste tank/riser/etc (bounding case uses bounding sludge slurry material)
   b. waste spills (or sprays for case of small leak) into box/pit/tank/riser until transfer terminated
   c. airborne release occurs due to free fall spill (and spraying in case of small leaks), splashing, and then indoor aerodynamic entrainment from resulting pool due to indoor wind effects (outdoor aerodynamic entrainment occurs if spill size larger than volume of box/pit/tank/riser/etc.)

Several transfer error scenarios were determined to be incredible based on facility configuration or involve negligible risk. These are identified in DSA Table 3.3-11 along with the rationale for the determination. DOE review of Tables 3.3-11 found the rationale/justifications to be fully adequate.

Two transfer error scenarios identified in the HA were subsequently determined to not require any controls. These scenarios (Fire in Cell, Cell Cover Drop During Transfer) were associated with the Low Point Drain Tank on the interarea line between H-Tank Farm and Saltstone (located in Z-Area). The waste allowed to be transferred to Saltstone is very low curie material and release of this waste does not warrant any particular safety class or safety significant controls. DOE review concurs with this conclusion.

Many of the initiators and locations for a transfer error scenario lead to consequences which represent significant risk to onsite and offsite receptors. For the in-facility workers, the controls necessary to provide adequate protection were qualitatively determined (consistent with guidance in DOE-STD-3009-94) and are identified in DSA Tables 3.3-13 through 3.3-15. DOE review of these tables concluded the controls were adequate and appropriate.

For those transfer error scenarios which represented a significant offsite and co-located onsite worker risk, detailed accident analyses were performed in calculation S-CLC-G-00236. To provide a conservative treatment of the possible mechanical failures in the transfer system, pipe breaks resulting in large leak rates (and associated ARFs/RFs) were analyzed separately from sprays resulting from small pipe cracks,

valve packing failures, flange leaks, etc. (and associated larger ARFs/RFs). DOE performed a detailed review of calculation S-CLC-G-00236 regarding the inputs and assumptions as well as the actual consequence calculations for HDB-2.

Key inputs were verified:

1. HDB-2 volume; drawings W702642 and W702648, and calculation M-CLC-G-00283, Rev. 2
   - including subtraction of volume from internal equipment (10%) and residual waste (1.29%)
2. Height of spill location of $\leq$ 3 meters
   - drawings W702642 and W702648 show this is supported, both inside the box and outside the box if leak caused box to overflow onto ground surface
   - walkdown of box performed and visually verified distance from ground surface to box cover was < 3 meters
3. Leak Path Factor (LPF) of 1 for unmitigated case (conservative)
4. ARF/RF values for free fall spill, indoor resuspension, and pressurized spray were verified to be consistent with DOE-HDBK-3010
   - ARF/RF for pressurized spray assumed 25% of spray was aerosolized through a commercial nozzle and 75% of spray experienced free fall spill. This judgement is reasonable and appropriate, especially when combined with the postulated worst case of spraying sludge slurry
5. Exposure durations:
   - offsite uses 8 hours for leak and spray, consistent with DOE-STD-3009-94
   - onsite uses 3 hours for leak (1 hour release and 2 hours to evacuate)
   - onsite uses 8 hours for spray (6 hour release and 2 hours to evacuate)
6. Unmitigated case leak/spray volumes were as follows:
   a. Leak events - 15,000 gallons
   b. Spray events – 6 hours @ 5.2 gpm = 1872 gallons
   - the use of 5.2 gpm for spray events is based on calculation S-CLC-G-00241, which summarized past leaks, including pressurized leaks.

   These volumes were based on the recognition that transfers are an intentional, deliberate activity, conducted in accordance with approved procedures, with attendant equipment to detect leaks (probes, bubblers, ARMs, CAMs, storm water monitors, etc.), high dP on HEPA (from moisture buildup) in spray event, material balances, etc. Regarding the 15,000 gallon input, DSA section 3.4.1.5.2 includes the requirement for the Transfer Control Program to ensure material balances and transfer event monitoring are conducted on a periodicity based on flowrate and type (batch versus continuous) such that 15,000 gallons is protected.

   Additionally, the 15,000 gallon volume for leak events is based, in part, on the maximum flow rate from the largest pumps in the CSTF (Tank 40 and 51 transfer pumps) allowable to maintain the piping within its code allowable pressure rating of 150 psig. This, in turn, requires the speed on the Variable Frequency Drives (VFDs) associated with VFD-driven pumps to be limited. This is recognized in DSA section 3.4.1.5.2, which requires the VFD speed to be set and checked (tested) prior to initiating a transfer. This requirement is properly captured within the Transfer Control Program in DSA section 5.5.4.2.21 and TSR Administrative Control 5.8.2.21.

7. Ventilation flow of 75 scfm (for mitigated case only)
   - M-DCP-H-94116 states 300 scfm for the HDB-2 complex (four cells), so HDB-2 box itself would receive 75 scfm
8. HEPA efficiency of 90% (for mitigated case only)
   - DSA section 3.4.1.5.1 requires ≥99.5% efficiency and Site Standard 15888 and Specification M-SPP-G-00243 require site HEPA filters have a ≥99.97% efficiency

The key assumptions were reviewed by DOE and determined to be appropriate, conservative, and consistent with facility configuration and DOE guidance documents. Additionally, these key inputs were compared to the CSTF DSA Input Deck (calculation S-CLC-G-00235) and found to be consistent.

DOE reviewed and checked the math in calculation S-CLC-G-00236 for the HDB-2 leaks and spray events, both onsite (100m) and offsite for both unmitigated and mitigated cases. This review found the calculation consistent with the above key inputs and the mathematical computations were found to be accurate.

The results of these calculations were that the Transfer Error event for HDB-2 involved offsite doses (< 0.2 rem) well below the offsite EG of 25 rem, but onsite doses above the EG of 100 rem. Thus, two (2) safety significant controls were warranted per the guidance in Manual E7, Procedure 2.25. These two controls are (1) the core pipe (primary confinement prevents breaks, leaks, etc.) and (2) the HDB-2 box secondary containment and associated HEPA filter (secondary confinement provides significant holdup/filtration if leak occurs).

The DSA was reviewed and section 2.4.4.2 and Figure 2.15 (Diversion Box descriptions), section 3.4.2.9 Transfer Error DBA), Table 3.4-1 (Transfer Facility dimensional input), and Table 3.4-7 (Consequences from DBAs) were found to be fully consistent with the inputs, approach, and results of calculation S-CLC-G-00236.

The passive controls (core pipe and HDB-2 box/HEPA filter) are properly identified and evaluated in Chapter 4 to show they meet the safety significant function of confinement. The core pipe is upgraded to safety class due to its importance in the Seismic scenario and likewise shown to meet safety class requirements. Chapter 4, sections 4.3.1 (core pipes), 4.3.2 (jumpers/connectors), and 4.3.4 (diversion boxes), each recognize these passive features are credited for the HDB-2 Transfer Error event for confinement and identify the need for the Structural Integrity Program to assure continued functionality through inspections and testing. Other controls are needed for the numerous additional locations subject to potential transfer error scenarios. These are discussed in Section II.C (SSCs) and Section II.D (ACs) of this SER.

Several key administrative controls are needed to maintain the core pipe integrity function. These are shown in the table below.

POTENTIAL INTEGRITY IMPACT	DSA Section Addressing Impact	TSR Section Addressing Impact
Water hammer	5.5.4.2.21	5.8.2.21
VFD Over-pressure	5.5.4.2.21	5.8.2.21
Large external fire	5.5.4.2.6	5.8.2.6
Jumper tightness	5.5.4.2.16	5.8.2.16
Load Drop	5.5.4.2.5	5.8.2.5
Vehicle Crash	5.5.4.2.14	5.8.2.14
Siphon	5.5.4.2.21	5.8.2.21
Corrosion	5.5.4.2.13	5.8.2.13

The efficiency assumed for the HEPA filters (90%) associated with transfer facilities (pump pits, diversion boxes, etc.) are addressed in DSA section 5.5 and in the applicable TSR LCOs for the transfer facility. The LCO surveillances require the efficiency to be 99.5%, which is conservative to the DSA analysis assumption.

Calculation S-CLC-G-00236, DSA Chapters 3, 4, 5, and the TSRs were also reviewed for overall consistency with the inputs, approaches, and results for Transfer Errors in other locations (e.g., pump pits, waste tanks, above-ground pipes, etc.). This review found the calculation, DSA, and TSRs consistent and adequate. Additionally, for HDB-2 as well as the other locations of concern, the controls selected followed the selection hierarchy found in DOE-STD-3009-94 (e.g., passive over active, preventive over mitigative).

Based on the above evaluation, DOE concluded that the Transfer Error analyses were comprehensive, thorough, conservative, and fully adequate. Additionally, the controls derived were adequate to prevent and mitigate the scenarios of concern and followed the hierarchy of control selection found in DOE-STD-3009-94.

E. Aerosolization Event (DBA 3.4.2.10)

The DSA evaluated by this SER performs a detailed quantitative analysis of aerosolization events. It was determined that the unmitigated consequences of aerosolization were significant, exceeding both the onsite and offsite DOE EGs. However, with the identified safety class and safety significant items and Administrative Controls in place, all aerosolization scenarios are either prevented or their mitigated consequences lie acceptably below the EGs.

The bounding aerosolization events and their consequences are:

Unmitigated Onsite	Mitigated Onsite	Unmitigated Offsite	Mitigated Offsite
Diversion Box sump aerosolization: >100 rem	Advance Design Mixing Pump column air leak: 70 rem	Diversion Box sump aerosolization: 52 rem	Pulse Tube agitator sparging aerosolization: 7.6 rem

The unmitigated consequences of these bounding scenarios do exceed EGs, but when mitigated by crediting safety class and safety significant controls, they do not challenge the EGs. The credited safety-significant controls significantly reduce the consequences of the bounding events to a level acceptable to DOE. Although the ADMP column air leak event is 70% of the onsite EG, there is considerable conservatism built into the analysis of that scenario, such as: the maximum size air line break is assumed, and that the MAR is assumed to be Type IV waste tank slurry (maximizing consequences), plus conservative generic assumptions related to respirable aerosol deposition velocity, entrainment efficiency, and release duration. Also, the defense in depth safety significant control (Type IV tank ventilation with HEPA filter) reduces the consequences by a factor of ~4, thus reducing the 70 rem to 15. In addition, there are other non-credited defense in depth features mitigating this event (in particular the air column on the ADMP which is designed to withstand the air supply pressure), which further lowers its consequences.

Since most aerosolization events were in the Anticipated frequency bin, no detailed frequency analyses were performed and all the events were conservatively assumed to be Anticipated.

A detailed Hazard Analysis (HA) (S-CLC-H-00858) was performed, identifying 15 aerosolization events requiring further evaluation and accident analysis in the DSA. DOE assessed that HA adequately identified potential failure modes and that event initiators were credible. The HA also identified 34 aerosolization scenarios which were determined to be Beyond Extremely Unlikely, and appropriate bases for these exclusions were provided for each. The HA was reviewed for equipment failure modes, initiators and controls, and DOE determined that the causes of postulated events were reasonable and thorough, the preventive and mitigative features were credible and appropriate, and the assigned consequence levels were reasonable.

The Input Deck Calculation (S-CLC-G-00235) was also reviewed. DOE concluded that the inputs and assumptions for the systems and equipment related to aerosolization events were reasonable and justified, and were accurately carried into the other calculations and analyses.

The Aerosolization Accident Analysis Calculation (S-CLC-G-00260) was performed to determine the need for safety class and safety significant controls required for mitigation of the various aerosolization events. Descriptions, key inputs, assumptions and results were reviewed for consistency with that reported in DSA Chapter 3. The following describes these key inputs and assumptions, and provides DOE's evaluation of them.

1. Steam and air pressure: The steam pressure assumed in the unmitigated cases involving steam jets was 370 psig, which accounted for failure of multiple steam regulators and relief valves. The air pressure assumed in the unmitigated cases involving air jets was 200 psig. The air pressure assumed for the unmitigated cases involving the Pulse Tube Agitator in FPT-1 and the Diaphragm pump were 150 psig and 125 psig, respectively, based on the special air supplies to these two components (not part of normal Plant Air system). DOE review of these inputs found them appropriate and conservative.

2. No combination of aerosolization and heat up in steam jet scenarios: It could be postulated that the energy transfer from the steam to the liquid waste should be included in steam jet aerosolization. The overheating events are described elsewhere (DSA section 3.4.2.13). Adding these two events together would produce higher doses, but would be overly conservative since it would result in double counting some of the energy. The aerosolization scenario uses an entrainment model, which essentially assumes the steam jet blows through the liquid, carrying the droplets formed with the jet. It is not a sparging scenario where significant heat is transferred from the steam to the liquid. In aerosolization, steam interaction with the liquid waste is mechanical (i.e., kinetic energy transfer). As modeled, only about 33 BTU/lbm is available as thermal energy and for subsequent heat up of the waste. However, some of this energy is used in the head loss in the piping, leaving an estimated 22 BTU/lbm of energy actually available to heat up the vapor, tank walls, or liquid waste, which could result in a maximum dose increase of approximately 20%. However, the conservatisms used in S-CLC-G-00260 more than compensate for not including this energy transfer term in the aerosolization model. In particular, the calculation assumes particles created which are <20 μm are respirable (normally consider particles <10 μm are respirable) to account for potential evaporation of the particles during transport through the air. Additionally, the calculation uses the efficiency of entraining 50 μm particles to ensure all particles <20 μm are modeled as being entrained. The entrainment efficiency of 50 μm particles is a factor of ~40 higher than the entrainment efficiency of 20 μm particles and a factor of >500 than the entrainment efficiency of 10 μm particles. Given these two and the other areas of conservatism in the analysis, it would be overly restrictive and result in unrealistic results to double count the energy by adding the two phenomena together.

3. Isolation time for securing steam to failed jet: Operator intervention is credited for recovery from failure of a steam line during a steam jet transfer. The 2 hour time (1 hour if occurring in locations other than waste tanks) allowed for operations to identify and respond to a steam break is a reasonable and achievable time period.

4. Exposure times to offsite and onsite receptors: It is assumed that exposure duration equals accident scenario duration (e.g. up to 2 hours for steam jet events, 8 hours for air or liquid jet events) and aerosol release begins immediately. This assumption is reasonable since aerosol production ceases when the pump is secured or the steam jet is isolated, and is conservative since there will actually be some delay before aerosols can begin releasing.

5. Leak Path Factors: These were tailored to the type of tank being analyzed, and the air exchange rate was calculated based on its internal volume and surface area. This provided for more realistic results and minimized over-conservatism.

6. Material At Risk (MAR): The total amounts of material involved in the accident scenarios were calculated conservatively, using the maximum device flow rates and maximum accident durations.

7. Airborne Release Fractions (ARF) and Respirable Fraction (RF): DOE-HDBK-3010-94 could have been used to assign ARF/RF for venting of pressure below the liquid waste surface, but an alternate model was used to analyze CSTF. One-quarter scale aerosolization tests were conducted at Pacific Northwest Laboratory, and the results were used to develop a more appropriate model for CSTF scenarios.

The 15 events carried into the accident analysis are described below. The HA event number is shown in parentheses.

Steam Jet Events:
1. Pump Tank aerosolization due to steam jet (PP-74)
2. Pump Pit Sump aerosolization due to steam jet (PP-75)
3. Diversion Box Sump aerosolization due to steam jet (DB-34)
4. Waste Tank aerosolization due to steam jet (WT-47)
5. Waste Tank Annulus aerosolization due to steam jet (WT-51)
6. Air flow through annulus transfer steam jet aerosolization (WT-52)

Liquid Jet/Mixing Aerosolization Scenarios:
7. Centrifugal long shaft mixing pump aerosolization (WTE-15)
8. Diaphragm Pump air aerosolization (WTE-27)
9. Flygt Mixer aerosolization (WTE-30)
10. Advance Design Mixing Pump aerosolization (WRE-35)
11. Advance Design Mixing Pump column air leak (WRE-37)
12. Pulse Tube Agitator sparging aerosolization (FPP1-1)
13. Pulse Tube Agitator aspiration aerosolization (FPP1-3)

Dry Sludge Scenarios:
14. Excessive addition of liquid to dry sludge (DS-5)
15. Aerosolization in a dry sludge tank (DS-8)

The controls identified to prevent and/or mitigate these aerosolization events are listed below.

Safety class controls for Aerosolization events:
- Diversion Box Sump Steam Jets (including verification that jet discharge path is open prior to initiating transfer): jet integrity ensures confinement
- Pump Pit Sump Steam Jets: jet integrity ensures confinement
- Pump Tank Transfer Jet Control Program: governs waste transfers to prevent aerosolization
- Waste Tank (Type I, I, III, IIIA) Transfer Jet and Piping (including verification that jet discharge path is open prior to initiating transfer): jet and piping integrity ensures confinement

Safety significant controls for Aerosolization events:
- ADMP Air Supply Line Orifice: limits air supply pressure/flow rate to ADMP column
- Annulus Transfer Procedures: governs waste transfers, ensures filtered negative pressure ventilation
- Critical Lift Program: protects structural integrity of credited safety related SSCs
- Diversion Box Active Ventilation System: filters airborne releases within DBs
- Diversion Box: structure and HEPA confines waste and potential releases
- Dry Sludge Tank Liquid Addition Procedures: prevents aerosolization events
- PTA Pressure Relief Valves: limits pressure to system during pulse tube agitator operation

- Pump Pit Active Ventilation System: filters airborne releases within pump pits
- Pump Pit: structure and HEPA confines waste and potential releases
- Slurry Pump/Mixer Operation Control: governs operation (pump speed versus height of liquid cover) to prevent aerosolization
- PTA Low Pump Tank Liquid Level Interlock: ensures minimum liquid cover to prevent aerosolization during pulse tube agitator operation
- Waste Tank Ventilation System: filters airborne releases within waste tank
- Waste Tank Annulus Jet and Piping (including verification that jet discharge path is open prior to initiating transfer): jet and piping integrity ensures confinement
- Waste Tank Annulus: structure and HEPA confines waste and potential releases
- Waste Tank (Type IV) Transfer Jet and Piping (including verification that jet discharge path is open prior to initiating transfer): jet and piping integrity ensures confinement
- Waste Tank: structure and HEPA confines waste and potential releases

Consistency between DSA Chapters 3, 4, 5 and the TSR was evaluated by DOE and determined adequate. Hardware controls are adequately captured in DSA Chapter 4 and are addressed in Chapter 5 for input to the TSR. The necessary controls are also properly carried through into the TSR and governed by LCOs, Surveillance Requirements and Administrative Controls.

DOE reviewed the specified controls and found them to adequately prevent and/or mitigate aerosolization scenarios, to protect DSA assumptions, and to keep accident consequences acceptably less than EGs.

C. Safety Systems, Structures, Components (DSA Chapter 4)

C.0 The purpose of this chapter is to provide details on those facility structures, systems, and components that are necessary for the facility to satisfy EGs, provide defense in depth, or contribute to worker safety. Descriptions are provided of the functional requirements and performance criteria required to support the safety functions identified in the hazard and accident analyses and to support subsequent derivation of TSRs. Expected products of this chapter include:

- Descriptions of safety SSCs, including safety function
- Identification of support systems safety SSCs depend upon to carry out safety function
- Identification of functional requirements necessary for the safety SSCs to perform their safety functions, and the general conditions caused by postulated accidents under which the safety SSCs must operate
- Identification of the performance criteria necessary to provide reasonable assurance that the functional requirements will be met
- Identification of assumptions needing TSR coverage

C.1 Criteria: DOE-STD-3009-94, paragraph 4.1, Introduction, and 4.2, Requirements

This section provides an introduction to the contents of this chapter. Design codes, standards, regulations, and DOE Orders required for establishing the facility safety basis are identified.

Evaluation

The Introduction and Requirements sections adequately describe the purpose and scope of this chapter and reference the appropriate DOE Order and Standards from which the chapter was developed. 10 CFR 830 (Nuclear Safety Management), DOE-STD-1027-92 (Hazard Categorization and Accident Analysis Techniques), DOE-STD-1020-94 (Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities), and DOE-STD-3009-94 (Preparation Guide for DOE Nonreactor Nuclear Facilities Safety Analysis Reports) are the primary sources of requirements and guidance and are referenced. Also referenced are the WSRC Functional Classification Methodology Manual (WSRC-TM-93-9), Functional Classification Procedure (Manual E7, Procedure 2.25), and backfit analysis Process Procedure (Manual E7, Procedure 3.41).

Based on DOE review, the criteria to provide an introduction and to list applicable requirements documents have been met.

C.2 Criteria: DOE-STD-3009-94, paragraph 4.3.X.1, Safety Function (SC)

This section identifies safety class (SC) SSCs, the reason for their designation, and the specific identification of its preventive or mitigative safety function.

Evaluation

The process for selecting SC SSCs consisted of comparing predicted release consequences to off-site EGs; identifying appropriate safety functions; identifying and designating SSCs to meet these functions; and re-analysis of the consequences of the accident assuming that the SSCs are capable of carrying out the designated safety function.

SC SSCs have been identified, where necessary, for each of the accident scenarios that were evaluated in the accident analysis for the CSTF with reasons provided. The safety function of each SC SSC is identified with a reference to the applicable Chapter 3 accident scenario from which the SSC is credited. DOE found Chapter 3 and 4 internally consistent. Additionally, a detailed review of the safety functions validated that they are consistent with the assumptions contained in the accident analysis (Chapter 3).

Based on DOE review, the criteria to identify SC SSCs, the reason for their designation, and the preventive or mitigative feature provided has been met.

C.3 Criteria: DOE-STD-3009-94, paragraph 4.3.X.2, System Description (SC)

This section provides a description of the safety-class SSCs and the basic principles by which they perform their safety functions. The description includes the boundaries of the SSC and interface with other SSCs relevant to the safety function. A basic summation of the physical information known about the SSC, including Process and Instrumentation Drawings (P&IDs) or simplified system drawing with references to P&IDs is provided.

Evaluation

The SC SSCs that are necessary to perform the designated safety functions have been identified and described. DOE reviewed the SC SSC boundaries and interfaces with other SSCs, including the simplified drawings provided. The descriptions given were verified to match the principles which each SSC functions and matched the SSC configuration by comparing to existing P&IDs, as well as system operation documents.

Based on DOE review, criteria to describe SC SSCs, principles by which they perform their safety function, boundaries, and interfaces has been met.

C.4 Criteria: DOE-STD-3009-94, paragraph 4.3.X.3, Functional Requirements (SC)

This section identifies functional requirements for each SC SSC and any needed support SSCs. This section specifically addresses the pertinent response parameters or non-ambient environmental stresses related to an accident for which the safety function is being relied upon.

Evaluation

The functional requirements for each of the SC SSCs were reviewed and found to be consistent with the requirements and environmental conditions (i.e., accident conditions) derived in Chapter 3.

Based on DOE review, the criteria to identify functional requirements for each SC SSC has been met.

C.5 Criteria: DOE-STD-3009-94, paragraph 4.3.X.4, System Evaluation (SC)

This section identifies performance criteria necessary for demonstrating that SC SSCs can meet their functional requirements and thereby satisfy their safety function. This section provides a simple evaluation of the capabilities of the SSC to meet these performance criteria.

Evaluation

When evaluating the prevention/mitigation of the postulated accident, credit may be taken for the operability of a SC item provided that it meets the design requirements defined for safety class equipment (e.g., DOE Order 6430.1A or 420.1; Manual E7, Procedure 3.41). Table C.3 of this SER compares the criteria used in assessing the existing SC SSCs (using the backfit analysis method in Manual E7, Procedure 3.41) to the criteria imposed on new SC SSCs. This comparison shows the criteria used in the backfit analysis process is adequate.

The system evaluation performed for each of the SC SSCs, including associated backfit analysis packages referenced in the DSA, were reviewed and found acceptable. Additionally, DOE performed an independent failure modes and effects evaluation of the SC SSCs, Table C.1 in this SER, and found that the DSA adequately covers the failure modes identified.

DOE also performed an independent assessment of the vulnerability of electrically operated SC SSCs from lightning strikes. This assessment is shown in Table C.4 and shows that failures of the electrically operated SC SSCs from a lightning strike do not result in the inability to prevent/mitigate any of the accidents.

The SC Waste Tank Ventilation System is worthy of specific discussion/evaluation. This system is credited to provide two primary functions: (1) flammable gas removal, and (2) active filtration. The principal vulnerabilities of the first function during non-seismic events are evaluated in Table C.1 of this SER and are justified as-is due to the time available (≥7 days) before any tank would reach the LFL. However, some tanks could reach/exceed LFL in less than 7 days post-seismic due to the potential release of trapped gas within the sludge and/or salt cake within the tanks. This vulnerability is specifically discussed in DSA section 3.4.2.18 and evaluated in Section II.B of this SER. The second function of the waste tank ventilation system is credited principally to mitigate releases during activities inside the tank which represent potential aerosolization hazards. The primary vulnerability of this function is excessive moisture buildup on the HEPA filter and subsequent failure. This could occur if the condenser, demister, and/or reheater failed or were unable to remove sufficient moisture. To address this vulnerability, the DSA requires the HEPA filter dP gage to function and be

periodically monitored during these activities, which is implemented through. DSA Chapter 5, 5.5.4.2.47, and TSR AC 5.8.2.51.

Based on DOE review, the criteria to provide a system evaluation has been met.

C.6 Criteria: DOE-STD-3009-94, paragraph 4.3.X.5, Controls (TSRs) (SC)

This section identifies those assumptions requiring TSRs to ensure performance of the safety function.

Evaluation

DOE review has determined that all of the assumptions made in the accident analysis, for SC functions, have been properly identified in DSA Chapter 4. A comparison of the listed controls with the TSR document confirmed that all of the identified controls are included as Limiting Conditions of Operation (LCOs), Administrative Controls, or Design Features in the TSR.

Based on DOE review, the criteria to identify TSRs has been met.

C.7 Criteria: DOE-STD-3009-94, paragraph 4.4.X.1, Safety Function (SS)

This section identifies the SS SSC, the reason for their designation, and the preventive or mitigative feature they provide.

Evaluation

The process for selecting SS SSC consisted of: identifying significant worker hazards, safety functions necessary to control the hazard, and identifying and designating appropriate SSCs as SS; identifying and designating as SS equipment necessary to monitor, detect, or prevent a nuclear criticality; and identifying and designating SSCs important to the defense-in-depth of the facility. DOE found the Lines of Defense to be adequate and provide sufficient defense-in-depth.

SS SSCs have been identified, where necessary, for each of the accident scenarios that were evaluated in the accident analysis for the CSTF with reasons provided. The safety function of each SS SSC is identified with a reference to the applicable Chapter 3 accident scenario from which the SSC is credited. DOE found Chapter 3 and 4 internally consistent. A detailed review of the safety functions validated that they are consistent with the assumptions contained in the hazard and accident analysis (Chapter 3).

Based on DOE review, the criteria to identify SS SSCs, the reason for their designation, and the preventive or mitigative feature provided has been met.

C.8 Criteria: DOE-STD-3009-94, paragraph 4.4.X.2, System Description (SS)

This section provides a description of the safety significant SSCs and the basic principles by which they perform their safety functions. The description includes the boundaries of the SSC

and interface with other SSCs relevant to the safety function. A basic summation of the physical information known about the SSC, including P&IDs or simplified system drawing with references to P&IDs is provided.

Evaluation

The SS SSCs that are necessary to perform the designated safety functions have been identified and described. DOE reviewed the SS SSC boundaries and interfaces with other SSCs, including the simplified drawings provided. The descriptions given were verified to match the principles which each SSC functions and matched the SSC configuration by comparing to existing P&IDs, as well as system operation documents.

Based on DOE review, criteria to describe SS SSCs, principles by which they perform their safety function, boundaries, and interfaces has been met.

C.9 Criteria: DOE-STD-3009-94, paragraph 4.4.X.3, Functional Requirements (SS)

This section identifies functional requirements for each SS SSC and any needed support SS SSCs. This section specifically addresses the pertinent response parameters or non-ambient environmental stresses related to an accident for which the safety function is being relied upon.

Evaluation

The functional requirements for each of the SS SSCs were reviewed and found to be consistent with the requirements and environmental conditions (i.e., accident conditions) derived in Chapter 3.

Based on DOE review, the criteria to identify functional requirements for each SS SSCs has been met.

C.10 Criteria: DOE-STD-3009-94, paragraph 4.4.X.4, System Evaluation (SS)

This section identifies performance criteria necessary for demonstrating that SS SSCs can meet their functional requirements and thereby satisfy their safety function. This section provides a simple evaluation of the capabilities of the SSC to meet these performance criteria.

Evaluation

When evaluating the prevention/mitigation of the postulated accident, credit may be taken for the operability of a SS item provided that it meets the design requirements defined for safety significant equipment (e.g., DOE Order 6430.1A or 420.1; Manual E7, Procedure 3.41). Table C.3 of this SER compares the criteria used in assessing the existing SS SSCs (using the backfit analysis method in Manual E7, Procedure 3.41) to the criteria imposed on new SS SSCs. This comparison shows the criteria used in the backfit analysis process is adequate.

The system evaluation performed for each of the SS SSCs, including the associated backfit analysis packages referenced in the DSA, were reviewed and found complete and adequate.

Additionally, DOE performed a failure modes and effects evaluation of the SS SSCs, Table C.2 in this SER, and found that the DSA adequately covers the failure modes identified.

DOE also performed an assessment of the vulnerability of electrically operated SS SSCs from lightning strikes. This assessment is shown in Table C.4 and shows that failures of the electrically operated SS SSCs from a lightning strike does not result in the inability to prevent/mitigate any of the accidents. The only event for which a lightning strike could potentially cause an event prior to recovery actions would be if the lightning strike occurred such that it disabled the electrical distribution bus supplying power to the HDB-8 fans. This bus receives power from offsite sources as well as the HDB-8 DG. A lightning strike which disabled the bus itself would prevent power reaching either of the two ventilation fans. If the fans stopped while a waste transfer into one of the HDB-8 pump tanks continued (especially if this was a supernate jetted transfer), the time to reach LFL in the pump tank is very short (21 minutes worst case per calculation S-CLC-G-00209). The incoming transfer would not be supplied power from the HDB-8 bus. DSA section 4.4.10.3 addresses this vulnerability and concludes the risk of this sequence of events occurring is acceptable based on the low likelihood of a lightning strike occurring while a steam jetted transfer through a HDB8 pump tank is in progress and actually striking/disabling the susceptible components. DOE reviewed this assessment and concurs the risk is sufficiently low to not warrant any additional compensatory measures.

Several SS SSCs are worthy of specific discussion/evaluation.

Pump Tank/Pump Pit Ventilation Systems are credited with two primary functions: (1) flammable gas removal, and (2) active filtration. Under certain conditions, the time to reach LFL in Pump Tanks is very short (~21 minutes). The ventilation systems for the non-HDB8 Pump Tanks are not supplied with SS backup power. This vulnerability is recognized in DSA section 4.4.9.3 and is specifically evaluated in Section II.B, Attachment II.B, subsection C, of this SER. The SS HDB-8 Pump Tank ventilation system has redundancy in the active portions of the system, but is powered by a single SS distribution bus supplied by a single SS DG. This single electrical supply is vulnerable to a lightning strike, which is addressed above. The active filtration function of the Pump Tank/Pump Pit Ventilation Systems has the same vulnerability as the Waste Tank Ventilation System discussed in Section C.5 of this SER. To address this vulnerability, the HEPA filter dP gage is required to be functional and the HEPA filter dP is required to be periodically monitored.

Conductivity Probes are credited in various locations (tanks, sumps) to detect waste prior to being released. DOE reviewed the ORPS database and concluded these probes perform reliably in detecting liquid when liquid is present. Occasionally, conductivity probes have actuated when waste was not present due to moisture collecting on the probe assembly, but this is conservative.

The FPT-1 low level interlock is credited with automatically isolating the air supply valve to the FPT-1 Pulse Tube Agitator (PTA). DSA section 4.4.14 states that this interlock will automatically isolate the air supply valve if instrument air to the low level interlock dip tubes is lost. DOE reviewed drawings M-M6-F-3308 (Rev.10), M-M6-F-3870 (Rev. 3), M-M6-F-3350 (Rev. 11), and M-M5-G-0137 (Rev. 3), and discussed the operation of the FPT-1 low level interlock with the F-Tank Farm Maintenance Manager. The DOE assessment concluded

that loss of instrument air would cause the dip tubes to simulate a low level condition and actuate the interlock, which would cause the PTA air supply valve solenoid valve to vent air from the air supply valve, causing it to close.

DSA section 4.4.14 also does not specify a closure time for the FPT-1 PTA air supply valve. This air supply valve is air-operated and is held open with instrument air. The associated solenoid valve, upon receipt of a signal from low FPT-1 level or upon loss of air supply or upon a loss of power, vents air from the air supply valve, causing it to close. Information from the vendor (Herion) indicates both the solenoid valve and the air supply valve have operating times of 1-2 seconds or less. This is more than sufficient to ensure air is isolated to the FPT-1 PTA prior to liquid waste in FPT-1 being uncovered/aerosolized. Given the closure times involved, which is consistent with expected operation of small solenoid valves and air operated valves of this kind, no specific closure time in the TSRs is warranted.

Based on DOE review, the criteria to provide a system evaluation has been met.

C.11 Criteria: DOE-STD-3009-94, paragraph 4.4.X.5, Controls (TSRs) (SS)

This section identifies those assumptions requiring TSRs to ensure performance of the safety function.

Evaluation

DOE review has determined that all of the assumptions made in the hazard and accident analysis, for SS functions, have been properly identified. A comparison of the listed controls with the TSR document confirmed that all of the identified controls are included as Limiting Conditions of Operation (LCOs), Administrative Controls, or Design Features in the TSR.

Based on DOE review, the criteria to identify TSRs has been met.

Table C.1 - Failure Modes and Effects Evaluation for SC SSCs[1]

SC SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.3.X	Rationale for Acceptance of failure of non-SC SSC
Core Pipe	1. VFD causing over-pressure of pipe 2. Valve on discharge of transfer pump closes during transfer and dead-head pump 3. Steam jet supply pressure regulator fails - results in high pressure steam into core pipe, over-pressurizes pipe	1. No 2. No 3. No	1. Section 4.3.1.1 states core pipe protected from over-pressurization. Section 5.5.4.2.21 requires an over-pressure evaluation prior to initiating a transfer. If evaluation identifies potential for VFD to over-pressurize pipe, VFD speed setting to limit pump discharge pressure will be set and tested prior to transfer per 5.5.4.2.21. 2. Only manually operated valves exist on pump discharge. Section 5.5.4.2.21 requires discharge path to be verified open (i.e., no valves closed) prior to initiating transfer. 3. PRV on steam supply protects pressure
Jumper/Connector	Same as Core Pipe		
Transfer Line Isolation Valve	Same as Core Pipe		
DBs and VBs	None identified		
DB Sump Steam Jet (passive confinement)	1. Valve on discharge path closed resulting in steam discharge through jet suction leg	1. No	1. Only manually operated valves exist on jet discharge. Section 5.5.4.2.21 requires discharge path to be verified open (i.e., no valves closed) prior to initiating sump jet operation (considered to be a waste transfer).
PP	None identified		
PP Sump Steam Jet (passive confinement)	1. Valve on discharge path closed resulting in steam discharge through jet suction leg	1. No	1. Only manually operated valves exist on jet discharge. Section 5.5.4.2.21 requires discharge path to be verified open (i.e., no valves closed) prior to initiating sump jet operation (considered to be a waste transfer).

Table C.1 – (cont.)

SC SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.3.X	Rationale for Acceptance of failure of non-SC SSC
PTs	1. PP/PT ventilation system causing excessive negative pressure, imploding tank	1. Yes	1. PTs have an overflow line (and some have a passive vent device) which ensures sufficient inlet air to prevent excessive negative pressure.
	2. Valve on discharge path from PT closes, causing PT to become full of liquid and over-pressurized from incoming transfer pump if pump VFD failed/set incorrectly	2. Yes	2. PTs have an overflow line (and some have a passive vent device) which ensures sufficient venting to prevent over- pressure. The overflow line also prevents PT from becoming full of liquid.
	3. Air compressor malfunctions, causing excessive air through dip tubes, over-pressurizing PT.	3. Yes	3. PT overflow line, passive vent device, ventilation exhaust system provides sufficient pressure relief path.
	4. FPT-1 PTA air supply pressure regulator fails high, over-pressurizing PT	4. No	4. PT overflow line, passive vent device, ventilation exhaust system provides sufficient pressure relief path. Also, Air Supply PRV is credited SS.
	5. Organic-based lubricant in Air Compressor enters PT through dip tubes due to failed oil separator.	5. No	5. Section 5.5.4.3.45 requires prohibitions on compressor lubricants to prevent flammable gas being created in PTs.
	6. Agitator slurrying causes erosion of PT wall.	6. No	6. Design of Agitator and PT sufficient to prevent erosion and no evidence to suggest this has occurred.

Table C.1 – (cont.)

SC SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.3.X	Rationale for Acceptance of failure of non-SC SSC
Type I, II, III, IIIA Tanks	1. Excessive negative pressure in the annulus space from the annulus ventilation system causing primary tank wall failure 2. Annulus ventilation system operates for extended time without steam heaters during cold weather, causing tank wall exterior temperature to reach the NDTT and crack. 3. Annulus ventilation system and/or its heating coils fail, allowing moisture on exterior side walls, leading to corrosion. 4. Slurry/mixer pump operation leads to erosion of tank walls 5. Annulus ventilation outlet plugs and causes excessive positive pressure leading to implosion of primary tank. 6. Inlet damper for Purge exhaust system fails closed/isolated and excess vacuum created in tank	1. No 2. Yes 3. Yes 4. No 5. No 6. No	1. Table 3.3-11 shows that the installed annulus fans do not have the capability to draw sufficient vacuum to damage tank wall, and provides the negative pressure limits that any replacement or portable fans must stay within. 2. Section 4.3.10.2 states temperature controls for tank wall necessary to protect against brittle fracture and states this is part of Structural Integrity program. SI program description in section 5.5.4.2.12 adequately identifies this attribute. 3. Slow process. Also, section 4.3.10.2 identifies the need for corrosion controls on the tank primary walls. Section 5.5.4.2.13 specifically identifies the annulus ventilation system operation as part of the Corrosion Control Program. 4. No evidence of erosion on tank walls from sludge slurrying has been seen. Slurrying could reactivate existing leak sites, but this is addressed/bounded by the analyses for tank wall failures (0.4 gpm leak (non-seismic)). 5. Calculation M-CLC-G-00322 shows annulus fans cannot implode the tank. 6. BFA specifically addresses failure of inlet damper closed and shows the ventilation system flow is still provided and no excessive negative pressure observed. Chapter 4 of DSA specifically excludes inlet path from SC boundary.
HLLCP	1. Loss of power	1. Yes	1. Adequate justification provided in section 4.3.11.3 to account for loss of power.
Type I, II, III, IIIA Tank Ventilation System	1. Loss of power 2. Loss of steam causing loss of reheater function and subsequent pluggage of HEPA 3. Loss of cooling water to condenser causing eventual pluggage of HEPA 4. Steam leak through re-heater adding moisture, plugging or allowing channeling through HEPA	1. Yes 2. Yes 3. Yes 4. Yes	1/2/3/4 – Adequate justification provided in section 4.3.12.3 to show the SC function is not jeopardized; sufficient time (at least 7 days) before any tank would reach LFL after loss of ventilation flow and periodic flow verification is required via section 5.5.2.1 and TSR LCOs. 1/2/3/4 – SS function of ensuring active filtered ventilation during potential radiological release activities (e.g., transfer jet operation, slurrying), protected by periodic verification of flow, and verification of HEPA conditions is in TSR AC 5.8.2.50.

Table C.1 – (cont.)

SC SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.3.X	Rationale for Acceptance of failure of non-SC SSC
Waste Tank Ventilation Low Flow Interlock and Alarm	None identified		Section 4.3.13 commits this interlock and alarm to meet all SC requirements (SS for Type IV tanks) prior to use.
Waste Tank Mixing Device Breaker/Disconnect	None identified.		These devices interrupt power (manually and/or automatically) to mixing devices in waste tanks (e.g., slurry pumps). If power lost, function would be performed.
Waste Tank Steam Transfer Jet	1. Valve on discharge path closed resulting in steam discharge through jet suction leg	1. No	1. Only manually operated valves exist on jet discharge. Section 5.5.4.2.21 requires discharge path to be verified open (i.e., no valves closed) prior to initiating sump jet operation (considered to be a waste transfer).
Evaporator Cells	None identified		

Footnote:

1. II over I items are not listed. Also, external impacts due to vehicles, crane load drops, etc. are covered by Administrative Controls identified in Chapter 5.

Table C.2 - Failure Modes and Effects Evaluation for SS SSCs[1]

SS SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.4.X.2	Rationale for Acceptance of failure of non-SS SSC
Transfer Pump Breakers/Disconnects	None identified		
Waste Tank Transfer Jet Steam/Air Isolation Valves	None identified		
Transfer Line Jackets/Encasements	None identified		
DB/HPFP CPs and alarms	1. Loss of power	1. Yes	1. Adequate justification provided in section 4.4.4.3 to account for loss of power.
DB Ventilation System (HDB-6/7)	1. Loss of power 2. Loss of steam causing loss of reheater function and subsequent pluggage of HEPA 3. Loss of cooling water to condenser causing eventual pluggage of HEPA 4. Steam leak through re-heater adding moisture, plugging or allowing channeling through HEPA	1. Yes 2. Yes 3. Yes 4. Yes	1/2/3/4 – Adequate justification provided in section 4.4.5.3 to address SS flammability control function (periodic flow verification, dampers are passive, and non-credited loss of power to fan alarm). 1/2/3/4 – SS function of ensuring active filtered ventilation during potential radiological release activities (e.g., sump jet operation), protected by periodic verification of flow, and verification of HEPA conditions is in TSR AC 5.8.2.50.
HDB-4 Passive Vent	None identified		
VB CPs and alarms	1. Loss of power	1. Yes	1. Adequate justification provided in section 4.4.7.3 to account for loss of power.
PP CPs and alarms	1. Loss of power	1. Yes	1. Since PP probes are the 1st LOC, a loss of power to the probe alarm is provided.
PP Active Ventilation (on PTs with passive vent device)	1. Loss of power 2. Loss of steam causing loss of reheater function and subsequent pluggage of HEPA 3. Loss of cooling water to condenser causing eventual pluggage of HEPA 4. Steam leak through re-heater adding moisture, plugging or allowing channeling through HEPA	1. Yes 2. Yes 3. Yes 4. Yes	1/2/3/4 – Adequate justification provided in section 4.4.9.3 to address SS flammability control function (periodic flow verification, dampers are passive, and non-credited loss of power to fan alarm). 1/2/3/4 – SS function of ensuring active filtered ventilation during potential radiological release activities (e.g., sump jet operation), protected by periodic verification of flow, and verification of HEPA conditions . is in TSR AC 5.8.2.50.

Table C.2 – (cont.)

SS SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.4.X.2	Rationale for Acceptance of failure of non-SS SSC
HDB-8 Active Ventilation System	1. Loss of power 2. Loss of steam causing loss of reheater function and subsequent pluggage of HEPA 3. Loss of cooling water to condenser causing eventual pluggage of HEPA 4. Steam leak through re-heater adding moisture, plugging or allowing channeling through HEPA 5. Loss of DCS 6. Loss of air supply to fan suction dampers	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes	1/5/6 – These failures could cause either loss of fan flow or opening of suction dampers (causes flow re-circulation) and not adequately ventilate PT for flammability function. Periodic flow verification required. Loss of power/air/DCS ARP requires suction damper position verification. Loss of DCS could prevent credited auto-start of 2nd fan, but this DCS function is being replaced with hardwired interlock prior to implementation of the DSA/TSR per letters HLW-2002-00154 and HLW-2002-00086. 1/2/3/4 – SS function of ensuring active filtered ventilation during potential radiological release activities (e.g., sump jet operation), protected by periodic verification of flow, and verification of HEPA conditions is in TSR AC 5.8.2.50.
HDB-8 DGs	1. DCS failure	1. Yes	1. Same result and addressed by assessment above for HDB-8 Active Ventilation
LDB/MLDB/LPS	None identified		
LDB/MLDB/LPS CPs and alarms	1. Loss of power 2. Configuration control of LDB – failure to properly install drain plug	1. Yes 2. Yes	1. Adequate justification provided in section 4.4.13.3 to account for loss of power. 2. No/inadequate drain plug could prevent CP from detecting liquid – DSA requires drain plug to be installed.
FPT-1 PTA Low Level Interlock	1. Loss of power 2. Loss of air supply 3. Water accumulation in air supply lines and subsequent freezing in cold weather	1. Yes 2. Yes 3. Yes	1/2 - FPT-1 PTA air supply valve designed to fail closed on loss of power or air. There is a s 2nd non-credited air supply valve in series with credited valve for redundancy. Loss of air to the dip tube only would cause low FPT-1 level simulation and auto close PTA air supply valve. 3. Commitment made, and carried forward to TSRs, for Severe Weather program to ensure freezing in air lines does not occur.
FPT-1 PTA Air Supply PRV	None identified		
LDB Drain Cell	None identified		
ARM with Control Room Alarm	1. Loss of power	1. Yes	1. Loss of power to installed, permanent ARM will cause a local alarm and an alarm in the control room. This is reflected in section 4.4.17.
Waste Tank IW Manual Isolation Valves	None identified		

Table C.2 – (cont.)

SS SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.4.X.2	Rationale for Acceptance of failure of non-SS SSC
Type IIIA Tank CRW Cooling Coils (excluding Tank 35H)	1. Impact (erosion and/or significant liquid movement) from slurry pump operation	1. No	1. Chapter 3 (3.4.2.15) credits coil integrity, but recognizes that small leaks in coils could occur. These leaks would be detected by various methods depending on the size of the leak (regular coil pressure tests, surge tank level decreases, waste tank level increases, in-line radiation monitor, etc.) well before the assumed full guillotine break occurs. Thus, if slurry pump operation caused small leaks to occur, this would be detected and the coils would be isolated (per commitment in 3.4.2.15) before a large leak occurred concurrent with a break in the chromate cooling water lines exterior to the tank.
Waste Tank CRW Header Isolation Valves	None identified		
Waste Tank CRW Coil Siphon Breaks	None identified		
Tank 30 CRW Coil Isolation Valves	None identified		
Tank 29 and 31-35 Type III CRW Cooling Coils	1. Impact (erosion and/or significant liquid movement) from slurry pump operation	1. No	1. Chapter 3 (3.4.2.15) credits coil integrity, but recognizes that small leaks in coils could occur. These leaks would be detected by various methods depending on the size of the leak (regular coil pressure tests, surge tank level decreases, waste tank level increases, in-line radiation monitor, etc.) well before the assumed full guillotine break occurs. Thus, if slurry pump operation caused small leaks to occur, this would be detected and the coils would be isolated (per commitment in 3.4.2.15) before a large leak occurred concurrent with a break in the chromate cooling water lines exterior to the tank.
Type IV Waste Tanks	1. Slurry/mixer pump operation leads to erosion of tank walls	1. No	1. No evidence of erosion on tank walls from sludge slurrying has been seen. Slurrying could reactivate existing leak sites, but this would lead to subsurface ground release at slow rate. Ch 3 discusses that sufficient time exists to address this type of event.
	2. Inlet damper for Purge exhaust system fails closed/isolated and excess vacuum created in tank	2. No	2. BFA specifically addresses failure of inlet damper closed and shows the ventilation system flow is still provided and no excessive negative pressure observed. Chapter 4 of DSA specifically excludes inlet path from SS boundary.

Table C.2 – (cont.)

SS SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.4.X.2	Rationale for Acceptance of failure of non-SS SSC
Type IV Waste Tank Ventilation System	1. Loss of power 2. Loss of steam causing loss of reheater function and subsequent pluggage of HEPA 3. Steam leak through re-heater adding moisture, plugging or allowing channeling through HEPA	1. Yes 2. Yes 3. Yes	1/2/3 – Adequate justification provided in section 4.4.25.3 to show the SS function is not jeopardized; sufficient time (at least 7 days) before any tank would reach LFL after loss of ventilation flow and periodic flow verification is required via section 5.5.2.1 and TSR LCOs. 1/2/3 – SS function of ensuring active filtered ventilation during potential radiological release activities (e.g., transfer jet operation, slurrying), protected by periodic verification of flow, and verification of HEPA is in TSR AC 5.8.2.50.
Waste Tank Annulus	None identified		
Waste Tank Annulus Transfer Jet	None identified		
Type III/IIIA Annulus CP and alarm	1. Loss of power	1. Yes	1. Adequate justification provided in section 4.4.28.3 to account for loss of power.
Waste Tank Transfer Pump/Jet Riser	None identified		
Waste Tank Transfer Pump/Jet Riser CP and alarm	1. Loss of power	1. Yes	1. Adequate justification provided in section 4.4.30.3 to account for loss of power.
Waste Tank H_2 Monitor	1. Loss of power 2. Loss of IA	1. Yes 2. Yes	1/2 – adequate justification provided in section 4.4.31.3 to compensate for loss of power/air. Monitor only needed for periodic surveillances and each tank has at least 7 days to reach LFL.
Waste Tank H_2 Monitor Interlock and Alarm	None identified		Committed to meet SS upon installation
Catch Tank	None identified		
ADMP Air Supply Line Orifice	None identified		

Table C.2 – (cont.)

SS SSC Under Consideration	SSC Whose Failure Could Impact SSC under Consideration	Identified in Section 4.4.X.2	Rationale for Acceptance of failure of non-SS SSC
242-16F, 16H, 25H Evaporator Tube Bundle	None identified		
242-16F, 16H, 25H Evaporator Lance Air Supply Line Orifice	None identified		
242-16F, 16H, 25H Evaporator Lance Steam Supply Line Orifice	None identified		
242-16F, 16H Evaporator Tube Bundle Steam Supply PCV and PRV	None identified		
242-25H Evaporator Lance Steam PCV and PRV	None identified		

Footnote:

1. II over I items are not listed. Also, impacts due to vehicles, crane load drops, etc. are covered by Administrative Controls identified in Chapter 5.

Table C.3 - Comparison Between DOE Guide G420.1 and E7/3.41 BFA Criteria

Criteria in Guide G420.1 for New SSCs	SC Criteria in E7/3.41 to assess existing SSCs (and used in DSA Ch 4)	SS Criteria in E7/3.41 to assess existing SSCs (and used in DSA Ch 4)
Single Failure	Single Failure	[STD-3009-94, section 4.4.X.4, specifically states SS SSCs are not required to be designed to performance criteria traditionally associated with SC SSCs.]
EQ	EQ	EQ
Safe Failure Mode (most probable failure modes should cause SSC to fail in safe configuration)	[Covered by requirement to evaluate impact of support systems (i.e., loss of air, steam, power, etc.)]	Functionality (review of BFA packages show "Functionality" addresses reliability and QA)
QA	QA	Functionality (review of BFA packages show "Functionality" addresses reliability and QA) [Also, QA generically addressed in section 4.4 of Chapter 4.]
NPH (if applicable)	NPH (EBE, EBT, PMF, PMP)	NPH (EBE, EBT, PMF, PMP)
Nationally recognized codes (e.g., ASME, ACI, ANSI, API, IEEE, NFPA, etc.)	Nationally recognized codes (e.g., ASME, ACI, ANSI, API, IEEE, NFPA, etc.)	Functionality (review of BFA packages show "Functionality" addresses reliability and QA)
Maintainability	Maintainability	Maintainability
Testability	Testability	Testability
Human Factors	[Generically covered in DSA Chapter 13.]	[Generically covered in DSA Chapter 13.]
	Explosion/Fire Resistant	
	Internal Hazard Resistant	

Table C.4 - Lightning Vulnerability Assessment

Electrical Component Struck	Impact	Addressed in DSA Section 4.x or Section 3.4.2.20 (Loss of Offsite Power)	Justification/Comment
Bus supplying power to Waste Tank HLLCP	Loss of bus should be obvious due to numerous observable alarms/indications.	Yes	If lightning were to hit and disable only a select portion of circuit of the HLLCP, this could go undetected. Likelihood of this happening is low. Non-credited reel tapes and material balances would also detect increased tank level between HLLCP surveillances.
Bus supplying power to waste tank ventilation.	Loss of bus should be obvious due to numerous observable alarms/indications. Loss of bus could prevent both offsite power and non-credited DG from supplying power to ventilation fans.	Yes	Flammability Program ensures that, upon loss of ventilation flow, waste tanks have at least 7 days to reach LFL. TSR surveillances ensure loss of flow detected well before reaching LFL. Seven days is sufficient to restore power to fans or install portable ventilation units.
Bus supplying power to waste tank ventilation interlock	Loss of bus should be obvious due to numerous observable alarms/indications. Upon loss of power, interlock required to be designed to actuate.	Yes	Interlock required to be designed to actuate upon loss of power.
Bus supplying power to waste tank mixing device breaker/disconnect interlock	Loss of bus should be obvious due to numerous observable alarms/indications. Interlock required to be designed to actuate upon loss of power.	Yes	Interlock required to be designed to actuate upon loss of power.
Bus supplying power to DB, VB, LDB, HPFP, LPS, Drain Cell, Pump/Jet Riser Conductivity Probes	Loss of bus should be obvious due to numerous observable alarms/indications.	Yes	If lightning were to hit and disable only a select portion of circuit of the conductivity probe, this could go undetected. Likelihood of this happening is low. 1st LOC for these locations is core pipe, which lightning would not cause to leak, so having unknown inoperable conductivity probe between SRs would still not lead to overflow of box or deflagration in box.
Bus supplying power to DB ventilation systems	Loss of bus should be obvious due to numerous observable alarms/indications.	Yes	1st LOC for these locations is core pipe, which lightning would not cause to leak, so having unknown loss of ventilation flow between SRs would still not lead to deflagration in box.
Bus supplying power to PP Conductivity Probes	Loss of bus should be obvious due to numerous observable alarms/indications.	Yes	PP conductivity probes have loss of power alarm so even if lightning were to hit and disable power to just the conductivity probe circuit, this would be detected.

Table C.4 – (cont.)

Electrical Component Struck	Impact	Addressed in DSA Section 4.x or Section 3.4.2.20 (Loss of Offsite Power)	Justification/Comment
Bus supplying power to PP/PT ventilation system for PTs with passive vent devices	Loss of bus should be obvious due to numerous observable alarms/indications. Loss of bus could prevent both offsite power and non-credited DGs from supplying power to ventilation fans.	Yes	If PT not receiving a steam jetted transfer at time lightning strikes, the installed passive vent device keeps the PT and PP from reaching LFL beyond 14 days. TSR surveillance to verify ventilation flow is every 24 hours, thus loss would be detected. If PT is receiving a steam jetted transfer at time lightning strikes, passive vent device not adequate unless incoming transfer terminated within ~20-30 minutes. During steam jetted transfers, TSR SR to verify flow is every 10 minutes, so loss of ventilation flow will be detected. Additionally, for steam jetted transfers, TSR AC 5.8.2.37 requires a backup portable ventilation system with its power source to be installed and functional so it can be immediately started.
Bus supplying power to PP/PT ventilation system for PTs without passive vent devices (HDB8 PTs)	Loss of bus should be obvious due to numerous observable alarms/indications. Loss of bus could prevent both offsite power and HDB8 DG from supplying power to ventilation fans.	Yes	HDB8 PTs rely on the fact that upon loss of offsite power to the PT ventilation fans, the credited HDB8 DG will automatically supply power to the fans. As long as the lightning did not disable the bus supplying the fans (same bus is fed from offsite power and HDB8 DG), then this strategy works. However, if lightning strike disables this bus, then neither offsite nor the DG can supply power to the fan. There is no passive vent device on HDB8 PTs. DSA section 4.4.10.3 adequately addresses this vulnerability.
Bus supplying power to FPT-1 low level interlock	Loss of bus should be obvious due to numerous observable alarms/indications. Upon loss of power, interlock designed to actuate.	Yes	Interlock designed to actuate upon loss of power.
Bus supplying power to ARMs or ARMs themselves.	Loss of bus should be obvious due to numerous observable alarms/indications. Failure of ARM should actuate alarm in Control Room	No	1st LOC for events crediting the ARM is core pipe, which lightning would not cause to leak, so having unknown inoperable ARM between SRs would still not lead to leaks, spills, or overflows.

Table C.4 – (cont.)

Electrical Component Struck	Impact	Addressed in DSA Section 4.x or Section 3.4.2.20 (Loss of Offsite Power)	Justification/Comment
Bus supplying power to waste tank annulus Conductivity Probes	Loss of bus should be obvious due to numerous observable alarms/indications.	Yes	If lightning were to hit and disable only a select portion of circuit of the conductivity probe, this could go undetected. Likelihood of this happening is low. 1st LOC for these locations is waste tank wall and core pipe traversing the annulus, which lightning would not cause to leak, so having unknown inoperable conductivity probe between SRs would still not lead to leak into annulus.
Bus supplying power to waste tank hydrogen monitors.	Loss of bus should be obvious due to numerous observable alarms/indications.	Not directly, although 3.4.2.20 addresses waste tank explosions in general.	Hydrogen monitor is 2nd LOC, ventilation being first. Loss of monitoring would not cause hydrogen increase in waste tank. Additionally, Flammability Program ensures that, upon loss of ventilation flow, waste tanks have at least 7 days to reach LFL. TSR surveillances ensure loss of hydrogen monitor would be detected well before reaching LFL.

D. Derivation of Technical Safety Requirements (DSA Chapter 5)

D.1 Chapter Purpose and Discussion

The purpose of this chapter is to provide information that adequately describes the derivation of the Technical Safety Requirements (TSRs). The information satisfies the requirements of 10 CFR 830, "Nuclear Safety Management", Subpart B Section 830.205. 10 CFR 830 requirements are amplified in Appendix A to Subpart B, Section G and Table 4, and further specified in DOE-STD-3009-94, Chapter 5.0.

This chapter builds upon the control functions determined to be essential in Chapter 3, Hazard and Accident Analysis" and Chapter 4, "Safety Structures Systems, and Components," to derive TSRs. This chapter covers the determination of TSRs which consists of summaries and references to pertinent sections of the Documented Safety Analysis (DSA) in which design (SSCs) and administrative features (non-SSCs) are required to prevent or mitigate the consequences of accidents. Design and administrative features addressed include ones which: (1) provide significant defense-in-depth; (2) provide for significant worker safety; or (3) maintain consequences of facility operations below EGs discussed and evaluated in Chapter 3 of this SER. Expected products of this chapter (based on a graded approach) include:

- Information with sufficient basis from which to derive any of the TSR parameters for individual LCOs.
- Information with sufficient basis from which to derive TSR administrative controls or to specify programs necessary to perform institutional safety functions.
- Identification of passive design features addressed in the DSA for which specific TSRs are deemed unnecessary.
- Identification of TSRs from other facilities that affect the facility's safety basis.

10 CFR 830 Subpart B and Appendix A to Subpart B specify that the safety analysis thoroughly explore the safety acceptability of all modes of operation, set points and operational parameters, combinations of inoperable equipment, staffing and qualification levels of operating crews, and limitations of administrative controls to verify that operation anywhere within the envelope will afford adequate safety provisions. Safety analyses should furnish the information necessary to validate, confirm, derive or modify the bases for TSRs.

The DOE conducted a thorough in-depth review of the CSTF DSA for Chapter 5. Selected vertical slices of TSR derivations were conducted as well as selected review of safety basis calculations to enable developing a representative picture of the document's compliance with the DSA requirements of 10 CFR 830 for derivation of TSRs. The review of the CSTF TSRs is provided in Section III of this SER.

D.2 Acceptance Criteria and Evaluation

As stated above, the DSA must meet the requirements from DOE-STD-3009-94, Chapter 5.0, for the derivation of TSRs.

D.2.1 Introduction (DOE-STD-3009-94, Section 5.1)

Criteria

This section shall provide an introduction to the contents of this chapter based on the graded approach and includes objectives and scope specific to the chapter as developed.

Evaluation

Sections 5.1.1 and 5.1.2 provide the objectives and scope, respectively, for Chapter 5. DOE review found these sections adequately meet the requirements of DOE-STD- 3009-94, section 5.1.

D.2.2 Requirements (DOE-STD-3009-94, Section 5.2)

Criteria

This section shall list the design codes, standards, regulations, and DOE Orders that are required for establishing the safety basis of the facility. The intent is to provide only the requirements that are specific for this chapter and pertinent to the safety analysis, and not a comprehensive listing of all-industrial standards or codes or criteria. SRIDs may be referenced as appropriate.

Evaluation

The DOE reviewed section 5.2 of the chapter and found it adequately meets the requirements of DOE-STD-3009-94, section 5.2. Review of Chapter 5 did not identify any design code, standard, regulation, or DOE Order that was used specifically for this chapter that was not listed.

D.2.3 TSR Coverage (DOE-STD-3009-94, Section 5.3)

Criteria

This section shall provide assurances that TSR coverage for the facility is complete. This section lists the features identified in Chapters 3 and 4 of the DSA that are needed to provide significant defense in depth, provide for significant worker safety, and maintain consequences of facility operations below EGs. TSR SLs, LCSs, LCOs, Surveillance Requirements, Administrative Controls and Design Features are to be included in this presentation. This section will specifically note those safety SSCs listed, if any, that will not be provided with TSR coverage and provide accompanying explanation.

Evaluation

Section 5.3 covers the summation of those chapters (3 and 4) that discuss and develop the hazards/accident analyses, safety class and safety significant systems, structures, and components and the required TSRs to support maintaining the safety envelope. This section is

made up of 5.3, "TSR Coverage"; 5.3.1, "Safety Limits Coverage"; 5.3.2, "Limiting Control Settings Coverage"; and 5.3.3, "Limiting Conditions of Operations and Surveillance Requirement Coverage". DOE review determined the following:

1. Section 5.3, through use of Table 5.9-1, "Summary of Technical Safety Requirements", provides the recommended DOE-STD-3009-94 format for consolidating information from Chapters 3 and 4 which is used to confirm that TSR coverage for the facility is complete. DOE reviewed DSA Tables 4.3-1, 4.4-1, and a sampling of Tables 3.3-13 through 3.3-15 and selected scenario discussions in section 3.4 and concludes Table 5.9-1 adequately captures the information required by DOE-STD-3009-94. The DOE review found that the information provided adequately meets the requirements of DOE-STD-3009-94.

2. Section 5.3.1 discusses the justification for not imposing Safety Limits, and therefore not imposing Limiting Control Settings, 5.3.2, on the operation of CSTF as further discussed in section 5.2.5. DOE review found the justification and the content of this subsection to adequately meet the requirements of DOE-STD-3009-94.

3. Section 5.3.3 discusses the selection objectives of those TSRs that are developed as LCOs and further states the purpose in selecting surveillance activities to support the LCOs. This section specifies that the LCOs chosen ensure the safety envelope defined in Chapter 3 is maintained and that the SRs chosen provide assurance on a routine basis that the operability requirements detailed in Chapters 3 and 4 are met. DOE review found this subsection to adequately meet the requirements of DOE-STD-3009-94.

The DOE review concludes that section 5.3 as written adequately meets the requirements of DOE-STD-3009-94.

D.2.4 Derivation of Facility Modes (DOE-STD-3009-94, Section 5.4)

Criteria

This section shall derive basic operational modes (e.g., startup, operation, shutdown) used by the facility that are relevant to derivation of TSRs. The definition of modes required in this subsection expands and formalizes the information provided in Chapter 3, "Hazards and Accident Analyses", regarding operational conditions associated with accidents.

Evaluation

Derivation of facility modes is presented in DSA section 5.4. The derivation of facility modes takes into account those operations in the CSTF that are significant contributors to potential release scenarios. These operations were specifically evaluated to determine the requirements and limitations during normal operations. This evaluation was conducted for each of the five process areas: pump tanks, transfer lines, waste tanks, evaporators, and the Waste Management Facility (299-H). This evaluation also concluded that the movement of liquid waste along a transfer path of the following areas would be prohibited: F-Area Diversion Box (FDB)-1, FDB-5, FDB-6, HPP-1, F-Area Catch Tank, 242-F/H (1F/1H) Evaporators, F/H Concentrate Transfer Systems, In-Tank Precipitation Filter Stripper Building, Tank 16, 17, and 20.

The approach used to define subsequent facility modes was to identify additional restrictions to the normal operating conditions for each of the process areas. These additional restrictions then result in a subset of normal operations that place the process area in a considerably safer state, which form the basis for these subsequent facility modes. These resulting facility modes with each Process Area are:

Process Area: Pump Tanks
MODES: OPERATION, STANDBY, and REPAIR

Process Area: Transfer Lines
MODES: HIGH-REM TRANSFER and OPERATION

Process Area: Waste Storage Tanks
MODES: GAS RELEASE and OPERATION
NOTE: There were no changes made to Tank 48 controls. Tank 48 MODES will remain as OPERATION, WARM STANDBY and COLD STANDBY as previously identified by WSRC-SA-15 and WSRC-RP-94-303.

Although the CSTF evaporators and the 299-H Waste Management Facility are identified as major process areas of the facility, they are excluded from modes based on the results of the safety analysis. The safety analysis concluded there were no unmitigated consequences that would challenge the offsite or onsite EGs. Therefore, the Administrative Controls and Design Features control these process areas in the TSRs.

The DOE review concludes that section 5.4 as written adequately meets the requirements of DOE-STD-3009-94.

D.2.5 TSR Derivation (DOE-STD-3009-94, Section 5.5, 5.5.X, 5.5.X.1, 5.5.X.2, 5.5.X.3) for the following:

- [Applicable Hazards/Features/TSR "X"]
- Safety Limits (SLs), Limiting Control Settings (LCSs), Limiting Conditions of Operation (LCOs), and Surveillance Requirements (SRs)
- Administrative Controls.

<u>Criteria (a) - [Applicable Hazards/Features/TSR "X"]</u>

This subsection identifies the specific feature(s) listed from DOE-STD-3009-94, Section 5.3 (5.2.3 of this SER) and the relevant modes of operation. The information can be organized by hazard protected against, specific features, or by TSR.

<u>Evaluation</u>

The TSRs derived by section 5.5 are organized under major facility process areas and the applicable major accident scenarios that were analyzed by safety analysis. LCOs and related SRs are numbered, as they will appear in the CSTF TSRs document. The DOE concluded that this method of presentation was acceptable.

Criteria (b) - SLs, LCSs, LCOs, and SRs

This section shall provide the basis and information sufficient to derive Safety Limits, Limiting Control Settings, Limiting Condition for Operations, and Surveillance Requirements to support the facility TSR document required by 10 CFR 830. Safety analyses should furnish the information necessary to validate, confirm, derive or modify the bases for TSRs.

Evaluation

The DOE reviewed section 5.5 of the DSA to ensure the derivations adequately (1) considered all modes of operation, (2) contained necessary references supporting the statement/value, (3) considered combination of inoperable equipment, and (4) considered the limitations of administrative controls.

As defined in DOE G 423.1-1, Implementation Guide for use in Developing Technical Safety Requirements, safety limits are limits on process variables associated with those physical barriers that, if exceeded, could directly cause the failure of one or more barriers that prevent the uncontrolled release of radioactive or other hazardous materials, with the potential of consequences to the public above specified guidelines. Also defined in the Guide, Limiting Control Settings (LCS) are settings on safety systems that control process variables to prevent exceeding SLs. The Documented Safety Analysis did not determine any one-safety limit that, if exceeded, could cause such a failure. Similarly, no LCSs were identified.

DOE reviewed the passive barriers for primary waste confinement (e.g., core pipe, pump tanks, evaporators, and waste tanks) and the process variable (pressure) that, if exceeded, could cause uncontrolled release of radioactive/hazardous material. As shown in the DBAs in DSA section 3.4.2, none of these locations are such that the uncontrolled release due to over-pressurization due to mechanical pressurization sources (i.e., transfer jets/pumps, steam tube rupture inside evaporator) could challenge the offsite EG. Even though exceeding 100% LFL by itself would not cause the uncontrolled release of material, subsequent explosions in the core pipes, pump tanks, and evaporators do not challenge the offsite EG. Explosions in a waste tank would cause an uncontrolled release and could, depending on which tank, exceed the offsite EG. For non-seismic scenarios, every tank is controlled via Administrative Controls and LCOs such that at least 7 days exist upon loss of ventilation to reach 100% LFL. For seismic scenarios, other than 4 specific tanks, each waste tank would have at least 1 day (all but nine have at least 7 days, and many of these would never reach LFL) before reaching 100% LFL after a seismic event. For all but the 4 specific tanks, this time is sufficient such that a SL is not warranted and control via LCOs is appropriate. DOE evaluated and accepted the post-seismic risk associated with the specific 4 tanks in Section II.B.10 of this SER.

Based on the above discussion, no SLs, and therefore no LCS, are needed.

The information necessary for deriving Limiting Conditions for Operations (LCOs) and the appropriate surveillance requirements to ensure equipment operability has been presented in DSA section 5.5. In particular, Table 5.9-1 provides the safety class and safety significant control from Chapter 3, the associated functional classification, and the location within the

TSR document covering this control. DOE reviewed Table 5.9-1 and found it to contain the safety class and safety significant controls from Chapter 3.

Examples of a few key LCO derivations are discussed below:

- The derivations of the necessary controls associated with a waste transfer have been divided into two transfer types, HIGH-REM Transfer and a LOW-REM Transfer. The primary difference between the two transfer types is that HIGH-REM transfers have waste with a inhalation dose potential greater than 2.0E8 rem/gallon. For HIGH-REM transfers additional controls are required to be in place that are not necessary for LOW-REM transfers, such as: operable conductivity probes with control room notification, HDB-7 ventilation system and Area Radiation Monitors. For LOW-REM transfers, leak detection capability is still required (except for valve boxes and the high point flush pit), but surveillance requirements of the areas associated with the leak detection locations are less frequent. All waste transfers in F-Tank Farm are considered LOW-REM transfers with the exception of the HIGH POINT FLUSH PIT. As discussed in Section II.B.9 of this SER, sludge slurries in Tanks 33 and 34 in F-Area must be sampled prior to transferring the slurried material.

- Chapter 4 analyzed the acceptability of transfer line jumpers and connectors along a transfer path to have "drip-wise" leakage. "Drip-wise" leakage has been defined as not a continuous flow of material or spray. "Drip-wise" leakage is not expected to challenge the sump inventory residual limit identified in Chapter 3 for a given transfer. This is based on the requirement to perform periodic monitoring for the protection of the residual value of all areas up to the first sound isolation point along the transfer path. Based on the required surveillance and leak detection equipment associated with the leak collection locations, DOE found this allowance for "minor" contained leaks to be acceptable.

- Waste Storage Tank ventilation systems prevent a waste tank explosion by removing flammable vapors. Chapter 3 defines a Rapid Generation Tank as a tank that can go from 25% to 100% of the hydrogen Lower Flammability Limit (LFL) in less than 28 days in the event of a loss of ventilation. A Slow Generation Tank has been determined to go from 25% to 100% of the hydrogen Lower Flammability Limit (LFL) in greater than 28 days in the event of a loss of ventilation. Based on the above criteria, a minimum flow rate was determined for each type of waste tank (Rapid vs. Slow), and equipment was specified for verification of this flow rate. Because a Rapid tank can approach LFL more rapidly, ventilation systems are required to have an operable flow indicator for verification of the minimum flow through the tank. This is performed at least once every 24 hours. For Slow Generation Tanks, verification of ventilation flow through the tank is accomplished by visual and /or audible inspection that the exhaust fan is running. This is also accomplished at least every 24 hours. Along with this surveillance, verification of the exhaust fan to provide the necessary capacity for removing vapors from a Slow Generation Tank is required at least every two years. Based on the risk associated with each type of tank (Rapid and Slow) DOE found this approach to be acceptable.

  The paragraph above addresses the steady state ventilation requirements for Rapid and Slow Generation Tanks. If a waste tank is determined to have sufficient accumulated trapped gas to potentially cause the vapor space to exceed 25% LFL upon its release, the

tank requires additional controls to be in place prior to conducting activities which could cause the trapped gas to be released (slurry pump operation, interstitial liquid removal from salt cake, salt cake dissolution). These additional controls involve ventilation flow interlocks and high LFL monitor interlocks. DOE review of these controls determined they were provided with appropriate and adequate LCO requirements.

- Monitoring the annulus level ensures that the initial hydrogen concentration assumed in the safety analysis (analysis conservatively assumed the annulus vapor space was initially at 25% LFL prior to initiating the leak) is maintained. The TSR LCO implementing this function requires a maximum level for the waste tank annuli, and requires verification on a routine basis. Additionally, this Surveillance Requirement is used to protect the assumption that primary tank leakage into the annulus is identified soon enough to ensure mitigative actions are taken prior to the annulus reaching 100% LFL. This detection is not needed for the seismic initiated leakage scenario since the seismic event itself initiates action to check the annulus and take mitigative actions.

The unmitigated scenario in DSA section 3.4.2.12 assumed a primary tank leak was detected by the time the leaked waste reached the "residual" level, then the leak continued at the same rate for 10 more days. The 10 days was chosen to conservatively cover all initiators of leakage into the annulus, including a seismic event. For the non-seismic initiated primary tank leak, responding to a leaking tank, once detected in the annulus, would be much shorter. Using the assumptions in DSA section 3.4.2.12, the vapor space in the annulus for the non-seismic initiated primary tank leak scenario only increased from the initial 25% to ~35% LFL. For the Type III and IIIA tanks, the residual level is reached in approximately four days (assuming an empty annulus and a maximum non-seismic leak rate of 0.4 gpm). However, Type III and IIIA tanks have never leaked, have no known leak sites, were constructed with heat treatment, and are maintained by the corrosion control and structural integrity programs. The 0.4 gpm was conservatively used in the unmitigated calculation for convenience to be consistent with the analysis for Type I and II tanks. However, the 0.4 gpm is very conservative for Type III/IIIA tanks. For the Type I and II tanks, the residual levels are reached in approximately fourteen days (assuming an empty annulus and a maximum non-seismic leak rate of 0.4 gpm). These tanks are also covered by the corrosion control and structural integrity programs, but some are known to contain various leak sites. Finally, there are uncredited defense in depth features in place most of the time to detect primary tank leakage into the annulus other than the periodic verifications dictated by this Surveillance Requirement (e.g., annulus conductivity probes, annulus level dip tubes, annulus exhaust ventilation Continuous Air Monitors, reel tapes measuring primary tank level reduction).

For Type III/IIIA tanks, the analysis showed that after 15 days (calculation used 15 days instead of actual time line of 14 days for conservatism) of leaking at 0.4 gpm, the annulus only increased from the initial 25% LFL to ~35% LFL. Likewise, for the Type I and II tanks, the analysis showed that after 30 days (calculation used 30 days instead of actual time line of 24 days for conservatism) of leaking at 0.4 gpm, the annulus only increased from the initial 25% LFL to ~60% LFL. Even when the seismic initiated leak rate of 4 gpm for 10 days was used, the annulus vapor spaces only reached 45-60% LFL.

Based on all the considerations above, a 7 day surveillance frequency is more than adequate to detect primary tank leakage in sufficient time to ensure mitigative actions are taken prior to the annulus reaching 100% LFL.

TSR LCO 3.8.5, SR 4.8.5.1, submitted November 15, 2002, specifies that one of three means must be used to verify annulus level – conductivity probes, level dip tube bubblers, or visual-based method (e.g., camera). The Bases for this LCO provides the requirements necessary to ensure these means are functional prior to performing the surveillance. The DSA does not require either of these methods to be functionally classified as SS. DOE evaluated the DSA/TSR position that the equipment used to perform SR 4.8.5.1 does not have to be SS nor required to have surveillances per the TSR to ensure "Operability." The DOE evaluation concluded that selecting a SS SSC and ensuring this SSC is operable within the LCO would follow the hierarchy of control selection given in DOE-STD-3009-94. Although the primary tank leak into the annulus is a long progression, DOE concluded there was sufficient benefit in equipment reliability and annulus leak detection by specifying the annulus conductivity probes as SS and ensuring operability of these probes within LCO 3.8.5. Therefore, DOE identified the following Condition of Approval:

Condition of Approval: Revise all applicable DSA chapters (e.g., 3, 4, and 5) as well as TSR LCO 3.8.5 to designate the Type I, II, III, and IIIA conductivity probes as SS for the purpose of identifying primary tank leakage into the annulus, and to perform the requisite surveillance requirements to ensure these probes are operable for periodic annulus leak detection.

The DOE review concludes that section 5.5 as written adequately meets the requirements of DOE-STD-3009-94.

Criteria (c) - Administrative Controls

This section provides the basis and identifies information necessary to derive TSR Administrative Controls. This section is the only applicable section for those features listed in section 5.3, "TSR Coverage," that are provided with only TSR administrative controls. The rational necessary for assigning TSR Administrative Controls needs to be clearly and briefly stated. 10 CFR 830, Subpart B, Appendix A, Table 4, identifies the necessary information to include in the Administrative Control section.

The Administrative Control section of the TSR document will contain commitments to establish, maintain, and implement these programs at the facility and, as appropriate, facility staffing requirements.

Evaluation

DOE reviewed DSA Chapter 3.0 as well as the needed safety programs/controls to confirm that section 5.5.4 adequately captured the needed Administrative Controls. DOE review found this section to adequately meet the requirements of DOE-STD-3009-94 for content. The DOE review concluded these controls were properly included in the Administrative Control section of the Technical Safety Requirements. Below are a few key examples:

- Transfer Control Program - This program establishes the guidelines for all facilities initiating liquid transfers. Each facility is required to determine the type of transfer (HIGH REM or LOW REM, based on curie content); perform an evaluation of sludge slurry transfer not exceeding 16.7wt% (F-Tank Farm only); make a determination of transfer paths; and perform independent verification of proper valve alignments. Additionally, this Program requires that each implementing waste transfer procedure perform the necessary monitoring and material balances on a frequency such that detection and termination of ≤ 15,000 gallons of leaked/spilled waste will occur.
- High Efficiency Particulate Air Filter Program - This program ensures replacement of HEPA filters prior to exceeding the assumed radiological loading associated with the HEPA.
- Ventilation System Performance Monitoring - This program requires HEPA filter dP monitoring during defined activities where the HEPA filtration is credited as a second level of control for mitigating consequences. The activities of concern are those that could lead to increased aerosolization of waste (e.g., steam jetting, slurrying, etc.) addressed in DSA section 3.4.2.10 and High-Rem transfers through Type I/II tank annuli. DOE reviewed the derivation of an administrative control to accomplish this function versus crediting the dP monitor itself and including the dP monitor within the applicable LCO. From review of the guidance given in DOE-STD-3009-94 and TSR Guide G 423.1-1 concerning LCO and administrative controls for SS functions, DOE concluded the derivation of the subject administrative control was acceptable and within the guidance.
- Flammability Control Program - This program determines and tracks the time to the Lower Flammability Limit (LFL) for each waste tank to determine the individual waste tank classification, Rapid, Slow, or Very Slow hydrogen generation tanks.
- Evaporator Feed Qualification - This program ensures that the composition of waste streams received into the Evaporator Feed Tanks is within analyzed limits prior to the transfer into the evaporator pots. See additional evaluation in Section II.E (Chapter 6) of this SER.

Additionally, the DOE review of DSA section 5.5.5 concluded that the derivation of the minimum shift crew size adequately covered the operator actions identified in Chapters 3 and 4 of the DSA. The program requirements detail the minimum shift crew composition for safe operation of the facilities. Additionally, document HLW-CST-02-002 was developed and evaluated the minimum staffing needed as identified in the Administrative Controls during the accident analysis for a seismic event. The minimum staffing identified by the Administrative Controls compared to the action times of document HLW-CST-02-002 was found to be adequate.

D.2.6 Design Features (DOE-STD-3009-94, Section 5.6)

Criteria

This section shall identify and briefly describe the passive design features that, if altered or modified, would have a significant effect on safe operation. Simply reference Chapter 2, "Facility Description" if that chapter contains the desired information.

Evaluation

Section 5.6 identifies and describes the passive design features not covered in the TSRs with specific SL's, LCS's, or LCO's. It is broken into four sections and is supported by Table 5.9-1. Specially covered are vital passive design features that, if altered or modified, could have a significant effect on safety. Section 5.6.1 discusses vital passive components such as piping, vessels, supports, and confinement structures. Section 5.6.2 discusses configuration and physical arrangement of the components and structures. Section 5.6.3 discusses materials used in the construction of the CSTF. Section 5.6.4 discusses site characteristics of CSTF. DOE review of these sections determined the following:

Section 5.6.1 utilizes Chapter 4 to provide detailed descriptions of the design features identified. Table 5.9-1 is used to list these features. This section identifies the Administrative Control of Structural Integrity and the Preventative Maintenance program as methods of ensuring the continued operability of these "passive" items.

Section 5.6.2 discusses control of configuration and physical arrangement of CSTF components and structures. Table 5.9-1 is used to list these items. This subsection identifies the Administrative Control of the Configuration Control program to ensure control of these items which are discussed in Chapter 2 and 4 of the DSA.

Section 5.6.3 references Chapters 2 and 4 to identify materials that are considered critical to the function of those items selected as safety class and safety significant SSCs.

Section 5.6.4 references Chapters 1 to provide the site characteristics such as: the location of public access roads, co-located facilities, facility area boundaries, site boundaries, nearest residence distances. etc.

The DOE review found DSA section 5.6 to adequately meet the requirements of DOE-STD-3009-94 for the content of this information.

D.2.7 Interface With TSRs from Other Facilities (DOE-STD-3009-94, Section 5.7)

Criteria

This section shall summarize TSRs from other facilities that affect this facility's safety basis and briefly summarize the provisions of those TSRs.

Evaluation

This section discusses CSTF's interface with other facilities, as well as the specific TSR/OSR controls. Section 5.7.1 provides the facility interface overview for the transfer of radioactive waste into the CSTF. Section 5.7.2 provides the interface for coverage of Waste Acceptance Criteria and specific controls for the receiving facilities (Defense Waste Processing Facility, Saltstone, and Effluent Treatment Facility). DOE review found this section to adequately meet the requirements of DOE-STD-3009-94, section 5.7.

Conclusion

Chapter 5 of the DSA is acceptable. Based on the DOE review, the purpose and required elements of Section 5.1 of this SER have been satisfied.

E. Programmatic Control (DSA Chapters 6 through 17)

Programmatic controls are those facility specific programs or site-wide programs necessary to ensure safe operation of the facility on a day-to-day basis. The safety management process established by these programs is meant to assure that the facilities are designed, constructed, and operated in a manner which provides protection for the facility worker, the onsite worker, the public, and the environment from the hazards associated with routine facility operations. The safety programs discussed below are implemented through various WSRC site and facility manuals and procedures, cover a broad spectrum of safety concerns, and range from prevention of inadvertent criticality to management, organization, and institutional safety provisions.

Those programmatic elements necessary for maintaining the adequacy of the facility safety basis described in the DSA are:

- Prevention of Inadvertent Criticality (Chapter 6)
- Radiological Protection (Chapter 7)
- Hazardous Material Protection (Chapter 8)
- Radioactive and Hazardous Waste Management (Chapter 9)
- Initial Testing, In-Service Inspection and Maintenance (Chapter 10)
- Operational Safety (Chapter 11)
- Procedures and Training (Chapter 12)
- Human Factors (Chapter 13)
- Quality Assurance (Chapter 14)
- Emergency Preparedness (Chapter 15)
- Decontamination and Decommissioning (Chapter 16)
- Management, Organization, and Institutional Provisions (Chapter 17)

Each of the programmatic sections either contains a listing of the applicable design codes, standards, regulations, and DOE Orders which are required for establishing the safety basis of the facility or appropriately provides a reference to the Standards/Requirements Identification Document (S/RIDs). The scope provided for each of these chapters is considered to adequately satisfy the criteria established in DOE-STD-3009-94.

Where appropriate, facility specific applications and/or interfaces with the site-wide programs were identified in the applicable DSA section. The following is a sampling of the key programmatic chapter discussions indicating how the DSA addresses these facility specific applications and/or interfaces.

Chapter 6 (Prevention of Inadvertent Criticality): The DSA provides a discussion of four different activities that could be possible criticality concerns: waste storage, sludge mixing, salt removal, and waste evaporation. These activities accurately reflect tank farm activities.

Influent waste streams to the HLW storage tanks are sufficiently low in fissile material concentration and contain abundant neutron poisons to prevent criticality for infinite geometry storage conditions, and continue to have subcritical reactivity under all anticipated (normal and credible abnormal) conditions to which the waste will be subject during storage and

processing. The fissile material and the poisons are relatively insoluble in the alkaline chemistry necessary to be maintained for corrosion control in the waste tanks. No reliance on physical criticality controls is required.

The criticality safety basis for each waste phase is summarized below:

a. Supernate – solubility limitations in alkaline waste ensure fissile material concentrations well below safe concentrations given in ANS 8.1
b. Sludge – adequate ratio of abundant insoluble neutron poisons (e.g., Fe, Mn, U-238) to fissile material (includes fissile isotopes of uranium and plutonium) in excess of safe ratios and no mechanisms identified to selectively segregate fissile materials away from neutron poisons (includes sludge slurrying operations)
c. Salt cake storage – adequate ratio of abundant insoluble neutron poisons (e.g., Na, Zn, Cr, Fe) to fissile material (includes uranium and plutonium isotopes) in excess of safe ratios and/or areal density limits are met; no mechanisms identified to selectively segregate fissile materials away from neutron poisons during storage
d. Salt cake removal (interstitial liquid removal and salt cake dissolution) – insoluble uranium salts/compounds are greatly outnumbered by insoluble neutron poisons; there are no mechanisms identified to selectively segregate fissile materials away from insoluble neutron poisons and accumulate these fissile materials upon the salt cake surface. Prior to interstitial liquid removal and bulk salt cake dissolution, samples are taken from the salt cake to ensure the insoluble neutron poisons-to-fissile material ratios and/or other criticality safety parameters are satisfied.
e. Evaporator scale formation – feed material is monitored to ensure formation and accumulation of sodium aluminosilicate scale containing sodium diuranate solids is minimized (for 242-16H) and prevented (for 242-16F and 25H); enrichment of feed is sufficiently low (< 1.1%) for 242-16H; periodic visual inspections of evaporator pots for scale formation are performed; and controlled evacuations (siphons) are periodically conducted on 242-16F and –16H to ensure scale accumulation is not occurring.

2H NCSE/basis for accepting "elements of incredibility" –
The 242-16H Restart Nuclear Criticality Safety Evaluation (NCSE), N-NCS-H-00121, Rev. 1, evaluates operation of the 16H Evaporator with the potential formation of pure sodium diuranate scale formation. The NCSE identified those scenarios that could potentially supply the evaporator feed tank (Tank 43H) with increased uranium enrichment supernate, which could result in a criticality within the 242-16H Evaporator pot due to scale formation. The scenarios address intended and unintended transfers that could affect the feed to the evaporator pot. Evaluation of these scenarios concluded that a criticality in the 242-16H Evaporator pot due to scale formation is not a credible event due to the nature and number of contingencies that would have to fail or be violated. These scenarios were evaluated based on bounding process conditions that maximize the important parameters (i.e., enrichment) of each scenario. The NCSE also assumes that an enrichment monitoring program (with a 242-16H Evaporator system target enrichment of less than or equal to 0.7%) is in place for the 242-16H feed tank to support 242-16H Evaporator operation. In addition, the NCSE addresses the possibility that legacy scale deposits from the initial chemical cleaning may be present. Other assumptions (e.g., sampling, inspection, feed stream limitation) necessary for the NCSE conclusion to be valid are stated within the NCSE and further detailed in the enrichment monitoring program. These elements of incredibility are listed in Table 6.4.1 of the DSA and will be administered through routine Tank Farm practices and procedures.

DOE review of this NCSE found it to be consistent with DOE Standards 3007-93 (Change 1) and 1134-99.

3H/2F evaporator NCSE/basis for incredibility discussion -
A set of criteria for evaluating transfers identified as "Restricted Waste" (i.e., DWPF recycle or similar waste) to the 2F and 3H evaporators systems to prevent scale (i.e., silicon base scale containing uranium, termed "scale" in remainder of this SER) accumulation in the evaporators is provided in the requirements of DSA section 5.5.4.2.25. By preventing scale formation, the criticality safety basis for the 2F and 3H evaporator systems given in DSA Chapter 6 remains valid. Additionally, by preventing scale formation, the evaporator pot explosion scenario assumptions in DSA section 3.4.2.1 for hydrogen generation rate in the 2F and 3H evaporator remain valid. The adequacy and technical basis for these criteria is established in SRT-LWP-2001-00032, Rev. 1 (Ref. E.1). Criteria 1 is summarized below:

The average concentration of silicon in the process stream transferred to the evaporator must be less than 120% of the historical maximum silicon concentration for feed to the affected evaporator. While the chemistry that created the insoluble sodium aluminosilicate solid with uranium accumulation in the 2H evaporator pot is not fully understood at the present time, this criterion is appropriate because the cause and effect relationship is recognized with the startup and receipt of DWPF recycle, and analysis of tank samples taken since 1997 show silicon to be the limiting reagent for aluminosilicate solids formation. 120% of the historical maximum silicon concentration for 2F and 3H are projected to generate sodium aluminosilicate at a rate of at least one order of magnitude less than that which occurred in the 2H evaporator. The criteria requires that, prior to determining the historical maximum silicon concentration, it must be verified that scale formation has not occurred during the operating period.

The calculated sodium aluminosilicate formation rate from the combined transfers and the evaporator tank waste must be less than 110% of the historical maximum for feed to the affected evaporator. A 10% increase in the formation rate is projected to be at least an order of magnitude below that of 2H. SRT-LWP-2001-00032 provides a relationship of the ionic strength, free hydroxide concentration, and solubility product for aluminosilicate using the sodium ion concentration to approximate the solution ionic strength. SRT-LWP-2001-00032 provides an equation for estimating the amount of sodium aluminosilicate that will precipitate after the 3X concentration by evaporation and provides an estimate, using this equation, of the amount of sodium aluminosilicate solids formed from supernate from each of the 3H, 2F and 2H evaporator systems. SRT-LWP-2001-00032 states that the sodium ion concentration was used to approximate the solution ionic strength and that this ionic strength may not be appropriate for tanks very high in carbonate, oxalate, sulfate or phosphate concentrations, typically greater than 0.5M. To ensure application of the methodology in SRT-LWP-2001-00032 for determining compliance with this Criteria is appropriate, each pre-transfer analysis will include an evaluation of the concentrations of oxalates, carbonates, sulfates and phosphates against the assumptions in the methodology. Estimates of aluminosilicate solids for both "pre-DWPF" and "post-DWPF" 2H evaporator feed tank chemistry were provided in Table 1 of SRT-LWP-2001-00032 to show that the amount of aluminosilicate formed depends on the chemistry of the feed solution and the effect of changes to the chemistry of the 2H evaporator feed with respect to lower sodium levels and associated free hydroxide concentrations and higher silicon levels attributed to receipt of DWPF. For these analyses, it

is assumed that the transferred volume mixes with the feed and/or drop tank supernate and the mixture is fed to the evaporator. Table 1 of SRT-LWP-2001-00032 also provides estimated aluminosilicate solid phase formation using the equation in the report for the 3H and 2F evaporator systems and show that the receipts of "normal canyon waste" (i.e., low silicon and high free hydroxide concentration) into the 2F and 3H systems have low NaAlSi formation rates compared to the 2H system (.44g/L for 2F, 0.116 g/L for 3H and as high as 25 g/L for 2H).

For Restricted Waste transfers directly into the evaporator feed tank, the free hydroxide concentration of the transferred waste shall be greater than 1 molar (M). This ensures that waste less than 1M is first transferred through a drop tank. Small volumes (<10,000 gallons) of transfer wastes with free hydroxide concentrations that meet criteria for average Si concentration and NAS formation rate may be made into the evaporator feed tank if feed to the evaporator is stopped prior to initiation of the transfer and feed is not restarted until at least 24 hours after the transfer is complete. Delaying the restart of the evaporator for at least 24 hours minimizes the likelihood of the low hydroxide waste being fed to the evaporator without some mixing in the feed tank.

Restricted Waste transfers into the evaporator drop tank may be less than 1 molar free hydroxide provided that the combined contents are greater than 1 molar free hydroxide prior to the transfer to the feed tank. Alternatives are provided in the DSA criteria to either: 1) directly sample the waste (at the surface) to show that it has mixed adequately to increase the hydroxide concentration above 1 molar, or 2) maximize the likelihood that sufficient mixing will occur so that waste is greater than 1 molar hydroxide prior to being fed to an evaporator. The first alternative, Criteria 1.4.3.a, requires a waste level in the drop tank of greater than or equal to 120 inches above the downcomer discharge, which ensures a sufficient liquid level exists for mixing in the receiving tank. This criterion is established to maintain the evaporator feed above 1M because free hydroxide levels below 1M can lead to problems of low solubility and formation of species such as aluminate and do not reflect typical canyon waste which has been shown to not form NaAlSi solids.

Criteria 2 requires an Engineering Evaluation of CST facilities and system status prior to transferring DWPF Recycle or similar waste to unrestricted locations. This is to maintain configuration control and to assess the impact of introducing high silica waste into unrestricted locations (i.e., locations not containing Restricted Waste).

Criteria 3 in the DSA requires that the silicon concentration and sodium aluminosilicate formation rate be determined for the 2F and 3H evaporator systems based on their specific conditions. It also requires this baseline be updated once every six months based on sampling the feed and drop tanks to confirm baseline values, trend variations over time, and to confirm the effectiveness in limiting silicon and aluminosilicate formation in the evaporator systems.

Criteria 4 of the DSA requires periodic visual inspections of the internal surfaces of the 2F and 3H evaporator pots. Because the DSA criteria intentionally allow both the silicon concentration and the calculated solids formation rate for the 2F and 3H evaporator systems to increase over time, the DSA also includes controls to confirm that the 2F and 3H evaporator pots are not experiencing significant accumulation of scale as the operating envelope is expanded. The DSA allows the time interval for the visual inspections to be extended based

on the ability to perform a controlled siphon out of the evaporator pot at intervals of approximately every 30 days (720 hours) of evaporator operation, and comparing siphon flow to that obtained previously under clean evaporator pot conditions.

No evidence of significant scale formation has been found in either the 2F or 3H Evaporators. The supernate in Tanks 5F and 40H, both containing DWPF Recycle containing silica, were processed through the 2F and 3H evaporators. Both tanks were processed using the controls previously in JCO WSRC-TR-99-00205 Revision 7 with no accumulation of scale. The DSA maintains the same controls and provides the operating flexibility to qualify other waste tanks containing DWPF Recycle (and similar waste). Visual inspections of the 2F and 3H evaporator pots (References E.2 – E.6) since these controls were implemented via JCO Revision 7 have shown no NaAlSi deposits to date. Therefore, DOE concludes there is reasonable and sufficient assurance that the controls specified in DSA section 5.5.4.2.25 will continue to ensure negligible, if any, scale formation in the 2F and 3H evaporator systems. Therefore, the criticality safety basis and the hydrogen generation rate assumptions given in the DSA for the 2F and 3H evaporators remain valid.

One proposed activity, aluminum dissolution, requires additional study and is specifically prohibited. Additionally, use of oxalic acid for cleaning (e.g., waste tanks) is prohibited (without an NCSE) since the dissolution effects on the neutron poisons and the fissile material have not been addressed. The fissile material form specific to each tank farm, including uranium enrichments and plutonium isotopic distribution, is discussed. Maximum quantities are also provided. Review of the supporting calculations confirmed that the discussion in this section is adequately supported. Due to the nature of the waste (abundant poisons, low fissile concentration), and current tank farm processes (no mechanism to separate any significant amount of poisons from the fissile material or concentrate fissile materials without concentrating poisons), criticality is not a credible event. Since it is not a credible event, there is no single credible event that could cause a criticality. There are administrative criticality controls on the generator to ensure that waste destined for the tank farms is verified infinitely safe prior to transfer.

Chapter 7 (Radiation Protection Program): Facility operations interface was described in terms of the guidance and support provided by Radiological Protection Department (RPD); however, it was clearly stated that responsibility for radiological safety rests with the line organizations. On-site control of radiation exposure, contamination, and internal contamination is described by referencing the site level 5Q Manual. Several Articles from the 5Q Manual, such as those dealing with workplace awareness, internal exposure, temporary shielding, contamination control, and respiratory protection were reviewed and found to describe adequate controls. Facility level sampling and monitoring programs, including Area Radiation Monitoring, Continuous Air Monitoring, air sampling, personnel contamination monitoring, and ventilation monitoring, is appropriately described as being provided in the 5Q Manual. Environmental monitoring systems and programs are implemented by HLW Programs, RPD, SRTC and the Environmental Protection Department, with HLW Programs retaining overall responsibility and ownership of the program as it relates to CST Facilities.

Chapter 13 (Human Factors): DOE reviewed this chapter to ensure that it adequately evaluated the ability of the Operation staff to perform the actions identified in the accident analysis (DSA Chapter 3), both the credited actions to prevent/mitigate an event as well as those operator actions used in defining the unmitigated scenario progression.

DOE found that the criteria used to bin and evaluate the credited operator actions (i.e., credited actions in < 30 minutes versus credited actions in > 30 minutes) was appropriate and commensurate with the types of operator actions credited in DSA Chapter 3. Consistent with DSA Chapter 3, the only credited action to be accomplished in < 30 minutes is responding to a loss of non-HDB8 pump tank ventilation during certain steam jetted transfers. The response requires installation of a temporary ventilation system, which is directed by the TSR LCOs. This temporary ventilation system will be installed prior to initiating the transfer and the DSA commits to performing a Human Factors Analysis (HFA) as part of this installation. This HFA would be performed to the latest Human Factor requirements so would afford the appropriate design and installation to ensure the function was accomplished.

Chapter 13 also identified and addressed the actions used in defining the unmitigated scenarios. DOE review of this assessment found it to be adequate and consistent with DSA Chapter 3. The DOE assessment given in Table B.3 of this SER shows the actions addressed in DSA Chapter 13 (terminating transfer prior to exceeding 15,000 gallons of spilled/leaked waste; securing steam to a steam jet whose supply piping fails and aerosolizes waste; detect leakage from the primary tank to the annulus) can be accomplished within the assumptions in the accident analysis.

Chapter 15 (Emergency Preparedness): This chapter summarizes the facility Emergency Response Organization (ERO) as consisting of the Facility Emergency Coordinator (FEC), Operations Support Center Coordinator, Radiological Control Coordinators, Rally Point Coordinator, and Emergency Responses Teams. The F-Tank Farm or H-Tank Farm Shift Manager (or Shift Supervisor) on shift is identified as the individual responsible for directing the emergency response (i.e., the FEC). The SRS Emergency Plan (WSRC-SCD-7) is referenced for more specific information regarding authorities and responsibilities of key individuals and the communication chain for notifying, alerting, and mobilizing ERO personnel. The emergency plan has also been appropriately referenced to detail the relationships with offsite authorities and identify the prearranged plans for mutual assistance with non-DOE entities. This chapter summarizes the classification system used to recognize and assess an operational emergency and references the specific classification procedure (EPIP-CST-001). The authority to initially declare a facility emergency is identified as a non-delegable duty and rests with the FEC. Once the Emergency Operating Center is activated, the Emergency Director is responsible for any changes in classification or declaration of emergency classifications.

References

E.1 SRT-LWP-2001-00032, "Technical Requirements for Dispositioning Tank 40H Decants", W. Wilmarth, 12/20/00.

E.2 HLW-STE-2001-00365, "Evaluation of the 3H Evaporator Pot and Lance Line", 7/26/01

E.3 HLW-STE-2002-00274, "Evaluation of the 2F Evaporator Pot-7/17/02", 7/17/02

E.4 HLW-STE-2001-00585, "Evaluation of the 2F Evaporator Vessel", 12/3/01

E.5 HLW-STE-2001-00122, "Observations for 25H Evaporator Inspection", 3/14/01

E.6 HLW-STE-2002-00223, "Evaluation of the 3H Evaporator Pot Inspection for 6/5/02", 6/5/02

II.F Tank 48 (DSA Chapter 18 and Related TSRs)

In development of the Safety Strategy for preparation of the CSTF safety analysis to meet 10 CFR 830 (Reference F.1), the operations associated with the In-Tank Precipitation (ITP) process would not be included in the scope of the analysis. These operations have been prohibited, and all facilities necessary to operate the ITP process, except Tank 48, have been de-inventoried of benzene-generating material such that this unique hazard is no longer a concern. Prohibitions on the use of these facilities (e.g., Filter Cells, Filter Stripper Building, Cold Feeds Area, etc.) are included in DSA Chapter 3 and the TSRs. The potential hazards associated with benzene in Tank 48 still exist. Tank 48 is being kept isolated from the rest of the HLW process, and no sodium tetraphenylborate (STPB) is allowed to be added (i.e., Tank 48 is to remain status-quo until a defined disposition mechanism is in place to address the waste currently within Tank 48). Thus, the analyses for Tank 48 process accidents were not upgraded to meet the requirements of DOE-STD-3009-94. Instead, the existing analyses and controls from the In-Tank Processing Facility (ITPF) SAR Addendum, WSRC-SA-15, and Operational Safety Requirements, WSRC-RP-94-303, were carried as-is into Chapter 18 of the DSA and into the TSRs. Upon restoration of Tank 48 and related facilities to conditions that meet the criteria defined for non-benzene bearing tanks, these controls will be deleted from the DSA and TSRs.

Some of the analyses in DSA section 3.4.2 are applicable to Tank 48 in its isolated state (e.g., Waste Tank Aerosolization, Waste Tank Siphon/Pump Out), and thus the analyses and controls for these events apply to Tank 48. The DOE review of these events is addressed in Sections II.B, II.C, II.D, and III of this SER. This section of the SER (II.F) provides the evaluation of the description of the existing conditions, analyses, and controls for Tank 48 addressed in DSA Chapter 18.

As stated above, the analyses and controls previously in the ITPF SAR Addendum and OSRs for Tank 48 have been carried forward as-is into the CSTF DSA and TSRs. These analyses and controls have been previously reviewed and approved by DOE in Reference F.2. Since no new activities or limits are authorized for Tank 48, no new DOE reviews have been performed. Thus, this SER makes use of the basis contained within Reference F.2. For background on past reviews, see Reference F.2. This SER documents the specific bases for accepting the analysis and controls for Tank 48 for those events in DSA Chapter 18.

The In-Tank Precipitation (ITP) process, as originally designed, involves precipitation, adsorption, filtration, and washing to remove radioactive cesium and other radionuclides (primarily strontium, uranium, and plutonium) from the supernate and dissolved salt cake transferred into ITP from the F-Area and H-Area Tank Farms. This high activity precipitate would then be stored for transfer to DWPF. The remaining low activity solution, after being stripped of benzene by a counter-current flow of water-saturated nitrogen gas, would be transferred to the Saltstone Facility. The facilities used to accomplish the ITP process included: H-area Tanks 48, 49 and 50; the Filter/Stripper Building (FSB); Cold Feed Area (CFA); Precipitate Transfer Line Jackets; and the ITPF Control Building (241-82H). The ITP process was demonstrated in Tank 48 in 1983.

ITP Cycle 1 was to consist of the addition of sodium tetraphenylborate into Tank 48, precipitation and concentration (by filtration) of three (planned) batches of high-level-waste feed into Tank 48 from Tanks 38 and 41, and finally washing the resulting precipitate in preparation for transfer to Tank 49. These operations were not completed as unexpected developments related to the behavior of sodium tetraphenylborate were encountered. Reference F.2 provides a full discussion of the suspension of the ITP process. Accordingly operations originally authorized as part of the ITP process are now prohibited or restricted. These restrictions are clearly defined and discussed in greater detail throughout the DSA and appropriate controls were carried forward to the TSRs to protect these limitations.

The format of this section of the SER is laid out as follows:
- Identification of Significant Unique Hazards for Tank 48
- Analysis and Controls for Tank 48 Unique Hazards
- Adequacy of SSCs Credited as Controls for Tank 48 Unique Hazards
- TSRs for Tank 48

Identification of Significant Unique Hazards for Tank 48 -
Section 18.1 of the DSA discusses the unique hazards of primary concern for Tank 48: exposure of personnel to abnormal releases of benzene; benzene generation increasing the potential for deflagrations, and the precipitate drying and burning, which could transport radionuclides in the resulting smoke. The methodology used in identifying new hazards included correlating existing Tank Farm hazards (e.g., in the old Tank Farm SAR, DPSTSA-200-10, Supplement 18) to Tank 48, analyzing hazardous material inventories, and conducting process hazards reviews (PHRs). The methodology for conducting PHRs is specified in manual WSRC-IM-90-135, "SRS Process Safety Management Manual." The techniques identified in this WSRC manual for conducting hazards analyses are consistent with those used in the chemical industry and specifically with the "process hazards analysis" section of 29 CFR 1910.119. This methodology is judged appropriate by the DOE for Tank 48.

Many accidents previously analyzed are no longer credible due to cessation of processing and prohibitions on the delivery, storage and use of sodium tetraphenylborate at the facility. Events involving a benzene fire in an STPB tanker, an STPB tanker truck spill, a benzene fire in the Cold Feed Area (CFA), and a STPB spill in the CFA or near Tank 48 are no longer credible since the delivery, storage and use of STPB in the facility is prohibited. This prohibition is contained in an administrative control of the facility TSR.

The DOE review of section 18.1, and comparing to DOE/TIC 11603 Rev. 1, Appendix G, Order 6430.1A, and LA-10294-MS, concludes that a full range of events have been considered.

Analysis and Controls for Tank 48 Unique Hazards -
Section 18.2 of the DSA discusses the features (hardware and programs) in place to address the unique hazards in Tank 48. Of particular importance is the nitrogen purge ventilation system which exists on Tank 48. This system provides oxygen control as well as flammable gas concentration (fuel) control to maintain the vapor space below the Minimum Oxygen Concentration (MOC) and CLFL during activities which could cause elevated benzene releases from the waste. DOE review of the description and operation of the nitrogen purge ventilation

system found it to be accurate and consistent with design drawings and field configurations. It is noted that the same system (nitrogen purge ventilation) is installed on Tank 49 as well, and would be initiated if waste from Tank 48 had to be transferred to Tank 49 due to a leak in Tank 48. If this need arose, DSA section 18.1 states an approved Response Plan would be used to control the transfer from Tank 48 to 49.

Section 18.2 also discusses the methodology to use to determine the time for Tank 48 to reach LFL due to the generation of benzene and hydrogen. DOE review, including past application, of this methodology concluded it is adequate and conservative.

For each credible event evaluated in DSA sections 18.2 and 18.3, Background (which describes the event sequence), Initiator, Frequency, Consequences, and Mitigation sections are provided which give a clear understanding of the event and how it was evaluated. These sections were reviewed by DOE to ensure sufficient information was provided regarding the sequence of the event, the basis for the probability of the event occurring, the basis for the consequences if the event occurred, and what preventive/mitigative features were credited in each event. This review involved comparing sections within DSA Chapter 18 for internal consistency as well as reviewing source documents referenced in the DSA to ensure the conclusions and assumptions made in these source documents were properly incorporated.

Several events addressed in DSA Chapter 18 for Tank 48 (Abnormal Benzene Release, Large Liquid Waste Release and Fire, Fire in Tank 48 Ventilation System, Waste Tank Over-pressurization) were shown to be very low risk or not possible. DOE review of these events found these conclusions reasonable and supportable, including the restrictions and prohibitions in place and the experience in past operations on Tank 48. Events which represent potentially significant risk are evaluated below.

TANK 48 VAPOR EXPLOSION

The Tank 48 vapor explosion event frequency is categorized as an "Anticipated" event and is analyzed considering the current relatively low radionuclide concentration in the tank. The current deflagration consequence calculation (S-CLC-H-00735) using this representative inhalation dose potential shows that both onsite and offsite doses are significantly lower than the EGs for an Anticipated Event (<100 mrem offsite and onsite). Therefore, no mitigation is required other than that required to protect assumptions in the consequence calculations (e.g., inhalation dose potential control, liquid level control, and prohibition on transfers into Tank 48). However, a deflagration in a waste tank is considered unacceptable, and a mitigation strategy is described in the DSA to prevent a deflagration in Tank 48. The mitigation strategy has two elements, primary oxygen control and secondary fuel control when in inerted operations. When in non-inerted operations the primary mitigative strategy is fuel control. The principal method is the preservation of an inert tank atmosphere using facility nitrogen supplies. The second element is control of the fuel composition of the vapor and liquid phases in the tank. This two element strategy is the same approach previously used with some modifications to implementing requirements based on suspension of the ITP process, increased chemistry understanding and the reduction in potential consequences.

DOE reviewed the consequence calculation S-CLC-H-00735 and agrees that the calculation is appropriate and shows that the radiological consequences from deflagration of Tank 48 vapor space are significantly lower that the EGs for an Anticipated Event. The maximum calculated

dose for both onsite and offsite individuals is less than 100 mrem. Calculation S-CLC-H-00735 used the MACCS code (evaluated in Section II.B of this SER), but used dose conversion factors from ICRP-30, versus ICRP-68/72 used in the accident analyses in DSA Chapter 3. These earlier dose conversion factors from ICRP-30 are conservative to those in ICRP-68/72. To protect the assumptions of the consequence calculation regarding inhalation dose potential, TSR controls are implemented prohibiting transfer of waste to Tank 48. Additional controls were added to the second element (fuel control) including a prohibition on addition of STPB to Tank 48 and controls on tank temperature and free hydroxide concentration to minimize the benzene generation rate. Results of the ITP Chemistry Program (Ref. F.3) showed that temperatures below 40°C and hydroxide concentration above 0.6 Molar help to minimize the benzene generation rate. Accordingly, TSR controls were added to require Tank 48 temperature be maintained less than or equal to 35°C and free hydroxide concentration greater than or equal to 1.0 Molar.

The capability to inert Tank 48, using the Normal Nitrogen System to maintain oxygen concentration <8%, will be maintained. This system provides a supply of nitrogen sufficient to provide inerting capability on Tank 48 for 9 days. Additionally, a Standby Nitrogen System (SNS) with two trains, each capable of providing a 4-day supply of nitrogen serves as a backup. Although non-credited, the SNS was designed, procured, fabricated and installed to meet Safety Class requirements, and is thus capable of providing a highly reliable backup supply of nitrogen. Tank 48 is required to be in the inerted mode during periods when benzene generation rate may be elevated (slurry pump operation and water addition for benzene release verification). Report F.4 shows that Tank 48 is sufficiently leak tight to support tank inerting.

Tank 48 is permitted to be operated in the non-inerted mode during which fuel concentration in the tank is controlled. During this mode of operation, a continuous air purge of at least 300 scfm across the tank vapor space is maintained to eliminate any benzene and hydrogen in the vapor space and thus prevent buildup to flammable levels. This mode of operation can only be entered if benzene concentration and release rates are measured and verified to be low enough that at least 9 days to CLFL will be maintained in the tank following a loss of ventilation.

The time to CLFL depends on the rate that flammable vapors are produced/released. Operation of the slurry pumps liberates benzene and hydrogen retained within the waste resulting in elevated flammable vapor concentrations in the vapor space. A periodic slurry pump run program has been implemented to safely manage the inventory of flammable vapors that may be retained within the waste. This program is based on determining the maximum time that the tank can remain undisturbed and retain insufficient benzene and hydrogen to cause the tank's vapor space to reach CLFL if all of the retained flammable vapors were released plus an additional 9 days of free release of flammable vapors. This time, referred to as the Quiescent Time (Q-time), is calculated based upon the following conservative inputs and assumptions:

- The Quiescent Time is based upon reaching 100% CLFL from an initial condition of 37% CLFL in the vapor space.
- 100% of the benzene and hydrogen generated during the quiescent period has been retained within the waste and is instantaneously released into the vapor space where it remains for the next 9 days.
- All benzene and hydrogen generated in the 9 days that follow the release event is released into, and remains within, the tank vapor space.

- The tank's purge exhaust system fails at the same time as the release event and remains inoperable for the 9 days.

Two dedicated EPVEs are required to be maintained operable. One portable oxygen monitor and portable LEL monitor are required to be maintained operable. Applicability of nitrogen storage requirements and increased benzene measurements do not apply during non-inerted operation. Although the operability requirements for the nitrogen supply are relaxed during non-inerted operation, the supply must be maintained as a Safety Significant system for use during inerted operation, thus providing a high confidence level that it will be available if an unanticipated need arises. Relaxation of these controls is considered acceptable considering the limited quantities of benzene in the liquid, restrictions on activities that generate benzene and the low consequences of the analyzed event.

When Tank 48 is maintained inerted, a deflagration is mitigated/prevented, and consequently so is a solids fire since sufficient oxygen is not present to support a deflagration or a fire. During non-inerted operation, sufficient oxygen may be present to support combustion of dried solids. The DSA discusses that these solids are not easily ignited. A sustained flame or deflagration, as opposed to a spark, would be required to ignite them and then only if the solids water content is less than 27%. Reference F.5 concluded that tank deflagration would result in charring of any dry solids but would not result in a fire. Therefore, by having adequate controls to mitigate/prevent a Tank 48 deflagration, a solids fire in Tank 48 is also mitigated/prevented.

TANK 48 ANNULUS DEFLAGRATION/FIRE

The deflagration in Tank 48 annulus event is categorized as an "Anticipated" event. The source term for a Tank 48 annulus deflagration was calculated. The source term was found to be less than the source term for the primary tank deflagration, thus consequences for the annulus deflagration event are bounded by the tank deflagration event and are well below applicable EG's. DOE reviewed the calculation for annulus deflagration source term and found it adequate (Ref. F.6). Nevertheless, controls are implemented to prevent a deflagration in the annulus of Tank 48. Tank 48 is a Type IIIA tank that had lessons learned from earlier type tanks incorporated into their design. Features such as global stress relieving of the primary steel tank, chemistry control and tank wall temperature control were instituted to prevent leakage. Additionally, annual inspection of the outer tank wall will be performed to ensure leakage is not occurring and to prevent buildup of material should a small leak develop.

Additional mitigation measures that are not credited for this accident include the annulus CAMs, annulus ventilation system, annulus conductivity probes, and response procedures to address removal of waste material from the annulus.

EARTHQUAKE

The geotechnical-structural analysis performed for Tank 48 determined that no failure of the steel tank, concrete vault or the berm is expected.

A seismic event could fail the installed ventilation on Tank 48. Failure of the tank purge ventilation systems could result in buildup of a flammable gas mixture in the vapor space and lead to a deflagration if ventilation is not restored. A minimum of 9 days to CLFL is maintained for Tank 48, providing sufficient time to install backup ventilation. The

Emergency Portable Ventilation Equipment for Tank 48 can be installed and operated within 9 days after a seismic event.

A seismic event could liberate retained flammable vapors. A periodic slurry pump run program has been implemented to safely manage the inventory of flammable vapors that may be retained within the waste. This program is based on determining the maximum time that the tank can remain undisturbed and retain insufficient benzene to cause the tank's vapor space to reach CLFL if all of the retained flammable vapors were released. This time, referred to as the Quiescent Time (Q-time), is calculated based upon the following conservative inputs and assumptions:

- The Quiescent Time is based upon reaching 100% CLFL from an initial condition in the vapor space of 37% CLFL for Tank 48
- 100% of the hydrogen and/or benzene generated during the quiescent period has been retained within the waste and is instantaneously released into the vapor space where it remains for the next 9 days
- All benzene and/or hydrogen generated in the 9 days that follow the seismic event is released into, and remains within, the tank vapor space.
- The tank's purge exhaust system fails at the same time as the seismic event and remains inoperable for the 9 days.

Based on the controls in place for Tank 48, a deflagration is prevented such that the cumulative consequences reported in DSA sections 3.4.2.17 (Tornado/High Wind), 3.4.2.18 (Seismic), 3.4.2.19 (Wildland Fire), and 3.4.2.20 (Loss of Offsite Power) are not increased.

Based on the above, DOE concluded that DSA Chapter 18 provides a complete and adequate safety analysis for the unique hazards for Tank 48.

Adequacy of SSCs Credited as Controls for Tank 48 Unique Hazards

As shown above, by maintaining Tank 48 in its current isolated condition, the consequences of a deflagration in the primary tank or the secondary annulus would be well below the offsite and onsite EGs. Thus, per Manual E7, 2.25, no specific SC or SS controls would be needed for these two events, nor a Seismic event which initiated either of these. However, the Tank 48 HLLCP is required to protect the assumption that the Tank 48 liquid level does not exceed 252". The Tank 48 HLLCP is designated safety class and is the same component as the other Type IIIA tank HLLCPs which are safety class and shown fully adequate in DSA Chapter 4. Likewise, the Tank 48 structure (primary tank, annulus, concrete vault) is designated safety class and is the same as the other Type IIIA waste tanks which are safety class and shown fully adequate in DSA Chapter 4. The Tank 48 nitrogen purge/ventilation system, although not technically required to be safety significant, has been classified and maintained as such. Likewise, although not required, as stated earlier, the SNS for Tank 48 was designed, procured and installed for safety class application. The consequences of a Tank 48 annulus explosion do not warrant credited annulus leak detection. Thus, the Tank 48 conductivity probes are not designated safety significant, but are the same component existing in other Type IIIA tank annuli, which are safety significant and shown fully acceptable in DSA Chapter 4. DSA Chapter 18 discusses many other specific features which are in place to prevent or mitigate the significant hazards posed by Tank 48. DOE review of DSA Chapter 18 concludes the SSCs identified are fully adequate to perform their functions.

TSRs for Tank 48 –
To satisfy the requirements identified in DSA Chapter 18 for Tank 48 (those required initial condition assumptions such as tank level as well as the prevention/mitigation "commitments" made in each Tank 48 DBA), certain TSRs were necessary.

The following LCOs were reviewed by DOE to verify that LCOs, including supporting surveillance requirements, are in place for system/equipment credited in DSA Chapter 18 for maintaining Tank 48 within the safe operating envelope.

- Tank 48 Waste Tank Nitrogen Inerting System (LCO 3.2.1)
- Tank 48 Emergency Purge Ventilation Equipment (LCO 3.2.2)
- Tank 48 Fill Limits and Tank Level Instrumentation (LCO 3.2.7)
- Tank 48 Purge Exhaust Ventilation System (LCO 3.2.10)
- Tank 48 Normal Nitrogen Supply System (LCO 3.2.11)
- Tank 48 Flammable Vapor Monitoring Requirements (LCO 3.3.1)
- Tank 48 Oxygen Monitoring Requirements (LCO 3.3.4)

The LCOs, including the mitigating actions to be taken, the surveillance requirements, and the associated Bases section, were reviewed by DOE and were found to be acceptable and consistent with the analyses in DSA Chapter 18.

The Tank 48 ventilation system is identified in DSA Chapters 3 and 4 as performing a SS function for aerosolization events (slurry pump operation) and requires the same HEPA filter efficiency as other waste tanks. Reference F.8 submitted addendum changes to TSR LCO 3.2.10 to provide the necessary surveillance for Tank 48 HEPA filter efficiency similar to the surveillance in LCO 3.8.1 for other tanks.

Several Administrative Controls were necessary to maintain the requirements within DSA Chapter 18. These were:

- Maintaining at least 9 days from 37% to 100% CLFL during non-inerted operations
- Restrictions on liquid (non-waste) additions into Tank 48
- Periodic slurry pump runs to control flammable vapor inventory within the waste, and associated restrictions during pump runs
- Determine benzene release rates during certain operations
- Maintain waste temperature $\leq 35^{\circ}C$ and free hydroxide ≥ 1.0 molar
- Prevent inadvertent tetraphenylborate additions to Tank 48 by double valve isolation, jumper removal, or blanked penetration
- Periodic inspections on conservation vent and vacuum breaker associated with Tank 48 ventilation system
- Perform independent verification of chemicals prior to unloading to Tank 48

These administrative controls are captured in TSR section 5.8.2.48, which DOE reviewed and found to be complete and consistent with DSA Chapter 18.

Likewise, certain prohibitions are necessary to maintain the safety basis in Chapter 18. These were:

- Chemical Cleaning, including oxalic acid additions, in Tank 48 prohibited
- Delivery, storage, or use of STPB in CSTF prohibited (excluding incidental samples, but samples cannot be disposed of in CSTF waste tanks)
- Processing operations (concentration/washing) in Tank 48 and transfers from Tank 48 to Filter Stripper Building prohibited
- Waste additions/transfers to or from Tank 48 prohibited
- Use of Cold Feeds Area to Tank 48 chemical addition line prohibited

These administrative controls are captured in TSR section 5.8.2.49, which DOE reviewed and found to be complete and consistent with DSA Chapter 18.

Based on the above, DOE concluded that the CSTF TSRs properly captured the safety analysis requirements from DSA Chapter 18.

References

F.1 Letter, Anderson to Piccolo, "Safety Strategy for Preparation of the Consolidated Concentration, Storage, and Transfer Facility (CSTF) Safety Basis Documents to Meet 10CFR830," PC-02-012, 12/11/02

F.2 Letter, Anderson to Piccolo, "Approval of the In-Tank Processing Facility (ITPF) Safety Analysis Report (SAR) Addendum (WSRC-SA-15) Revision 10," PC-01-034, 5/23/01

F.3 Jacobs, R. A., Summary of the In-Tank Precipitation Chemistry Program (U), WSRC-RP-98-00300, Rev. 0, 7/14/98.

F.4 Hyde, D. C., Tank 48 Hydraulic Resistance Evaluation (U), HLW-WPE-99-0019, 11/23/98.

F.5 Thomas, J.K., Potential for a Solids Fire during an ITP Waste Tank Deflagration and the Impact on Gas Pressure (U), WSRC-RP-93-997, dated July 1993.

F.6 Thomas, J. K.; Source Term for a Waste Tank Annulus Deflagration (U), M-CLC-H-01878, Rev. 0, 2/26/99.

F.7 McKeel, C. A., Telescoping Transfer Pump NPH Analysis (U), T-CLC-H-00215, August 1995.

F.8 Letter, Piccolo to Anderson, "Submittal of Changes to the Concentration, Storage, and Transfer Facilities Documented Safety Analysis and Technical Safety Requirements with DOE for Approval," HLW-2002-00164, 12/11/02

III. Technical Safety Requirements Approval Basis

Document Purpose and Discussion

In accordance with 10 CFR 830 and DOE G 423.1-1, Technical Safety Requirements (TSR) shall establish limits, controls, and related actions necessary for the safe operation of a nuclear facility. This includes operating limits and surveillance requirements, the basis thereof, safety boundaries, and management or administrative controls necessary to protect the health and safety of the public and to minimize the potential risk to workers from the uncontrolled release of radioactive or other hazardous materials. The facility specific Documented Safety Analysis (DSA), and especially the safety analyses contained therein, will serve as the source document for the setpoints, limits, staffing requirements, and other parameters for input into the TSRs. Examples of requirements expected to be provided include: operating limits for principal process parameters, technical and administrative conditions that must be met, availability of safety equipment and systems, and critical functions of instrumentation and controls. Operation within the bounds of the TSRs will provide reasonable assurance that the nuclear facility will not threaten the health and safety of the public or pose an undue risk to workers from uncontrolled releases of radioactive or other hazardous materials.

In areas that the DSA does not directly supply all of the input for the TSRs, such as surveillance intervals and surveillance acceptance criteria, national and international codes, standards, and guides are to be used wherever possible. Use of a value less conservative than that expressed in applicable codes, standards, and guides should be justified in the DSA. Where conflicts exist, the selection of a particular code, standard, or guide should be justified; normally the most conservative should be selected. Where no code, standard, or guide is applicable, other documents such as risk assessments and manufacturer documentation, may serve as a basis; a justification should be placed in the DSA.

Acceptance Criteria and Evaluation

A. Use and Application (DOE G 423.1-1)

Criteria

This section of the TSR document shall contain the basic instructions for using and applying the safety restrictions contained in the TSRs. Definitions of terms, operating modes, frequency notations, and actions to be taken in the event of violation of TSR operating limits or surveillance requirements are included in this section.

Evaluation

The DOE reviewed section 1.0 of the TSRs to ensure consistency with the guidance provided in DOE G 423.1-1 as well as to ensure the information provided was accurate and applicable to the configuration and potential operations of the CSTF. The DOE review concluded that this section adequately meets the requirements of DOE G 423.1-1.

B. Safety Limits (SL) (DOE G 423.1-1)

Criteria

This section should describe as precisely as possible the parameters being limited and state the limit in measurable units. This section should also include an applicability statement, which shall consist of a simple list of modes or other conditions for which the Safety Limit is applicable. Action Statements are to be included and shall completely describe the actions to be taken in the event the Safety Limit is not met. The actions should bring the affected parameter immediately within the Safety Limit and should effect a shutdown of the affected system(s) within a justified facility specific time frame. A statement prohibiting restart must be included either in the Action Statement or may be in the Administrative Controls.

Evaluation

Section 2.1 of the TSR document states that based on the safety analysis and the criteria of DOE G 423.1-1, no SLs are required for the CSTF. This section references CSTF DSA Chapter 5 to support this conclusion. The DOE review found this section to adequately meet the requirements of DOE G 423.1-1.

C. Limiting Control Settings, Limiting Condition for Operation, Surveillance Requirements, and Bases (DOE G 423.1-1)

Criteria

This section shall contain the Limiting Control Settings (LCSs), and the Limiting Conditions for Operations (LCOs), as well as mode applicability information and Action Statements, and surveillance's for each requirement.

C.1 Criteria - Limiting Control Settings
LCS statements should described, as precisely as possible, the parameter being controlled and it's limit, or the limiting setting of the device to control it.

Evaluation

As defined by DOE G 423.1-1, LCSs are associated with SLs. Since no SLs were identified for the CSTF, there are no LCSs.

C.2 Criteria - Limiting Conditions for Operations

LCO statements should describe as precisely as possible, the lowest functional capability or performance level of equipment required for continued safe operation of the facility. LCO Mode Applicability Statements consist of a simple listing of the modes or conditions for which the LCO is applicable. Action Statements completely describe the action to be taken in the event that a LCO is not met.

C.2.1. Criteria - Applicability

This section should contain a simple listing of the Modes or Conditions for which the LCO is applicable.

C.2.2 Criteria - Actions

This section should contain ACTION statements that describe the actions to be taken in the event the LCO statement is not met.

C.2.3 Criteria - Surveillance Requirements

This section of the TSRs shall provide the Surveillance Requirements relating to test, calibration, or inspection to ensure that the necessary operability and quality of safety related SSCs and their support systems required for safe operation of the facility are maintained. This section shall contain the requirements necessary to maintain operation of the facility within the LCOs.

C.2.4 Criteria - Bases

The Bases shall provide summary statements of the reasons for the operating limits and associated surveillance requirements. The basis shall show how the numeric value, the condition, or the surveillance fulfills the purpose derived from the safety documentation. The Bases shall reference the more detailed basis in the derivation of the TSRs in the DSA. The Bases shall also provide justification for the Action Times allowed when the LCO Condition statements are met.

Evaluation

The DOE reviewed sections 3.0, 4.0, and the corresponding Bases of the TSRs to ensure these TSRs contained necessary operating limits for principal process parameters, technical and administrative conditions which must be met, availability of safety equipment and systems, and critical functions of instrumentation and controls; and to ensure the LCOs and SRs (a) were supported by derivations from Chapter 5 of the DSA, (b) considered all modes of operation, (c) contained necessary references supporting the statement/value, (d) considered combination of inoperable equipment, and (e) were clearly written.

Examples of a few key LCOs are:
LCO 3.7.1, Pump Pit Sumps: This LCO is designed to prevent an above ground release of waste being transferred in the event of a transfer system leak. This LCO requires an OPERABLE conductivity probe with control room notification to detect an increase in liquid level above the required setpoint. In the event of receiving an alarm, the LCO describes actions to secure the movement of waste and actions necessary to ensure the facility remains in a safe configuration and to lower the waste level in the sump. The frequency of the associated surveillance ensures the equipment remains OPERABLE, and the BASES supports the analysis defined in Chapter 3 of the DSA

LCO 3.8.1, Waste Tank Purge Ventilation System: This LCO requires that the waste tank ventilation system be OPERABLE. To be OPERABLE, all waste tank ventilation systems require a fan capable of generating the required purge flow through the system, an intact flow path, and an exhaust filter capable of removing radioactive particulate from the exhaust stream. Additionally, if the waste tank is determined to be a RAPID generation tank, it will require an exhaust flow indicator to verify the minimum required value of 72 scfm. Action statements describing required actions in the event that the purge ventilation is not operating or at the required flow rate are specified. Additionally, surveillance requirements and their required frequencies are adequate to ensure operability of the system. This is also described in more detail in the BASES section and corresponds to Chapter 3 requirements.

LCO 3.8.10, Hydrogen Monitoring-GAS RELEASE: This LCO requires that the waste tank vapor space hydrogen concentration be less than or equal to 15% of the lower flammability limit (LFL) and the installed monitors be OPERABLE with control room alarms and interlocks. There are sufficient Action statements that requires stopping waste transfers, slurry pump/mixer operations, and salt dissolution activities in the event the LFL vapor space is challenged or if equipment, alarms, and interlocks are inoperable. The frequency of the surveillance requirements will ensure all required equipment remains OPERABLE, and the BASES supports the analysis of Chapter 3 of the DSA.

As defined in TSR section 1.2, the instrument Setpoint values given in the LCO and associated Surveillance Requirements reflect the Instrument Uncertainty calculations referenced in the associated Bases section. Thus, for example, if the DSA limit was 25% LFL and the total instrument loop uncertainty was 10% LFL, then the LCO/SR value would be 15% LFL. TSR section 1.2, however, also identifies the fact that there are allowable values ("as-found") and calibration tolerance values ("as-left") which must be derived using the methodology in ANSI/ISA-67.04.01-2000. This is appropriate because each instrument loop can drift in between surveillances so long as the drift is within the allowances evaluated in the Instrument Uncertainty calculation – this is known as the "allowable value" or the "as found value" (i.e., the value "found" during the Instrument Loop Test prior to recalibration). Also, to ensure the instrument loop starts at a point such that it will not drift outside the allowable value, the surveillance has to ensure the instrument loop is recalibrated to within the calibration tolerance value evalued in the Instrument Uncertainty calculation – this is known as the "as-left" value (i.e., the value "left" after recalibration during the Instrument Loop Test). If the Instrument Loop test showed the instrument loop was within the calibration tolerance, no recalibration would be necessary. DOE review of this practice found it appropriate and consistent with ISA-67.04.01-2000.

Based on the DOE review above, the CSTF LCOs/SRs/Bases adequately establishes and maintains the DSA defined safety envelope.

D. Administrative Controls (DOE G 423.1-1)

Criteria

This section shall contain the requirements associated with Administrative Controls including those for reporting deviations from TSRs. Staffing requirements for facility positions important

to safe operation of the facility shall be provided in this section. Physical and administrative controls of the criticality safety program shall be provided in this section.

Evaluation

The DOE review found this section to adequately meet the requirements of DOE G 423.1-1. A few key Administrative Controls are:

- Transfer Control Program- This program is required to be met by all facilities initiating liquid transfers. Each facility is required to determine the type of transfer (HIGH REM or LOW REM, based on curie content), over pressurization evaluations, independent verifications of correct transfer path alignment, and required flushes of core piping at the conclusion of the transfer. These controls will be proceduralized to ensure compliance.

- Flammability Control Program- This program determines and tracks the time to LFL for waste tanks to ensure that there is greater than 7 days before reaching LFL in the waste tanks if a seismic event occurred and to identify any waste tanks that may reach LFL in less than 7 days. Programmatic controls shall be established to ensure this requirement is achieved.

- Minimum Staffing- This program details the minimum shift crew composition for safe operations and the allowable hours to work during a specified period. Additionally, document HLW-CST-02-002 was developed and evaluated the minimum staffing needed as identified in the Administrative Controls during the accident analysis for a seismic event. A review of the minimum staffing identified by the Administrative Controls and compared to the action times of document HLW-CST-02-002 was found to be adequate.

The administrative controls identified in Chapter 5 as well as those specifically required by DOE G 423.1-1 were verified by DOE to be appropriately included in section 5 of the TSRs.

E. Design Features (DOE G 423.1-1)

Criteria

This section describes in detail those features not covered elsewhere in the TSRs that, if altered or modified, would have a significant effect on safety. This includes vital passive safety SSCs and configuration or physical arrangement.

Evaluation

Section 6.0 identifies and describes the passive design features and passive structures, systems and components (SSCs) not specifically required to have SL's, LCS's, or LCO's. The descriptions consist of an overview as well as Table 6.1.2-1, "Design Features", that provide specific listings of the applicable passive SSCs, safety feature summary, and design configurations summary. Table 6.1.2-1 also provides a cross-reference to the DSA Chapter 4 that provides additional information of the SSCs design features.

The DOE review found this section to adequately meet the requirements of DOE G 423.1-1.

Conclusion

The Technical Safety Requirements were found to be acceptable. Based on the DOE review, the purpose and required elements of Section III of this SER have been satisfied.

APPENDIX A

CSTF DSA/TSR DOE REVIEW TEAM
[for SER Revision 0]

Name	Responsibility
Larry Hinson	DSA Executive Summary
Sue Aleman	SER Independent Reviewer
Sherry Southern	DSA Chapter 1 Site Description
Larry Hinson	DSA Chapter 2 Facility Description
Don Blake	DSA Chapter 3 HAA
Tom Temple[1]	Transfer Error
Jose Blanco[1]	Evaporator Explosion
Jimmy Guerry[1]	Evaporator Overpressure
Jim O'Connor[1]	Transfer Facility Explosion
John Smartt[1]	Aerosolization Events
Tom Temple	DSA Chapter 4, Safety SSCs
Scott Nicholson	DSA Chapter 5, TSR Derivation
Don Blake	DSA Chapter 6, Nuclear Criticality
Sherry Southern	DSA Chapter 7, Radiation Protection
Sherry Southern	DSA Chapter 8, Hazardous Material
Sherry Southern	DSA Chapter 9, Radioactive/Hazardous Waste Management
Sherry Southern	DSA Chapter 10, Testing, Surveillance, Maintenance
Sherry Southern	DSA Chapter 11, Operational Safety
Sherry Southern	DSA Chapter 12, Procedures/Training
Sherry Southern	DSA Chapter 13, Human Factors
Tom Temple	DSA Chapter 13, Human Factors
Sherry Southern	DSA Chapter 14, QA
Sherry Southern	DSA Chapter 15, Emergency Preparedness
Sherry Southern	DSA Chapter 16, D&D
Sherry Southern	DSA Chapter 17, Management and Organization
Scott Nicholson	DSA Chapter 18, Tank 48 Accident Analysis
Scott Nicholson	TSR
Mike Dholakia	Structural Calculations
Brent Gutierrez	Structural Calculations

1. Vertical review of associated accident scenario. SAIC also performed a detailed review of consequence calculations for these accidents.

APPENDIX B

DRAFT DSA/TSR CHANGES TO ADDRESS CONDITION OF APPROVAL

3/4.8 WASTE STORAGE TANKS (EXCLUDING TANK 48)

3.8.5 Annulus Level / Ventilation

LCO 3.8.5: The liquid level in an annulus shall be less than or equal to the limits specified in Table 3.8.5-1.

AND

Forced ventilation shall be operated on Type I and II tank annuli at a frequency and duration sufficient to maintain the flammable vapor concentration of the annulus vapor space less than or equal to 25% of the LFL.

AND

One leak detection instrument listed in Table 3.8.5-1 or 3.8.5-2 shall be OPERABLE in each waste tank annulus when used to monitor annulus level for Surveillance Requirements.

MODE APPLICABILITY: All MODES

PROCESS AREA APPLICABILITY: Tanks 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49, 50, and 51

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The annulus liquid level is greater than the limit specified in Table 3.8.5-1. **OR** Forced ventilation has not operated as required on a Type I or II tank annulus. **OR** Required Actions and associated Completion Times of Condition B are not met. **OR** When directed by LCO 3.8.6 Condition B.	A.1 Stop all WASTE TRANSFERS through the affected tank annulus. **AND** A.2 Operate forced ventilation on the affected annulus for a minimum of 12 vapor space turnovers per the ERD. **AND** ---------- **NOTE** ---------- Negative pressure filtered annulus ventilation shall be used when jetting the annulus to meet Required Action A.3. See Administrative Control 5.8.2.23. ---------- A.3 Reduce annulus level to less than or equal to the limit specified in Table 3.8.5-1.	IMMEDIATELY 7 Days **AND** Every 7 Days thereafter 90 Days
B. A required leak detection instrument in Table 3.8.5-1 or 3.8.5-2 is inoperable when needed to monitor annulus level for SRs.	B.1 Verify annulus level is less than or equal to the limit of Table 3.8.5-1 or 3.8.5-2. **AND** B.2 Restore the required leak detection instrument to OPERABLE status.	3 Days **AND** every 7 Days thereafter 60 Days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
SR 4.8.5.1	Verify that the liquid level in an annulus is less than or equal to the limits specified in Table 3.8.5-.	7 Days
SR 4.8.5.2	Operate forced ventilation on the annulus of Type I and II tanks for a sufficient duration to provide 12 vapor space turnovers.	85 Days
SR 4.8.5.3	Perform an INSTRUMENT LOOP TEST on the annulus leak detection instruments identified in Tables 3.8.5-1 and 3.8.5-2.	7 Days
SR 4.8.5.4	Verify that the annulus leak detection instruments are set at or below the SETPOINT stated in Tables 3.8.5-1 and 3.8.5-2.	10 Years

CROSS REFERENCES

TITLE	NUMBER
Annulus Leak Detection Instruments	3.8.6

Replace with tables with individual rows for each credited CP – include CLIs

Table 3.8.5-1
Annulus Liquid Level
Required Parameters

PROCESS AREA	PARAMETER	REQUIRED VALUE (inches above annulus floor)
Type I Tanks 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	i. Annulus level	≤ 21 inches
Type II Tanks 13, 14, 15	i. Annulus level	≤ 23 inches
Type III Tanks 29, 30, 31, 32, 33, 34	i. Annulus level	≤ 5.5 inches
Type IIIA Tanks 25, 26, 27, 28, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49, 50, 51	i. Annulus level	≤ 5.8 inches

4.4.28 TYPE I/II/III/IIIA WASTE TANK ANNULUS CONDUCTIVITY PROBES AND HIGH LEVEL ALARMS

4.4.28.1 Safety Function and Functional Requirements

Type I/II/III/IIIA Waste Tank Annulus Conductivity Probes and High Level Alarms provide a control room alarm, upon the detection of a liquid waste level greater than the initial waste volume given in Chapter 3. The Annulus High Level Alarm is used to initiate operator actions to limit the quantity of radiological material to less than the initial waste volume given in Chapter 3.

The Type III/IIIA Waste Tank Annulus Conductivity Probes and High Level Alarms are credited as an SS control during High-Rem waste transfers for the following event:

- Transfer Error (Core pipe release into annulus)

The Type I/II/III/IIIA Waste Tank Annulus Conductivity Probes and High Level Alarms are designated, consistent with the hierarchy given in E7 Procedure 2.25 and to ensure the requisite reliability, as an SS control when used to monitor the annulus level for Initial Condition protection (Reference XXX).

4.4.28.2 System Description

There are three annulus conductivity probes positioned in the outer annuli for Waste Tanks 25-51. Waste Tanks 40, 41, and 42 have only one annulus conductivity probe that is hardwired into the control room. The center annulus conductivity probe is not credited as SS required equipment. The Type I/II Waste Tanks (Waste Tanks 1 -15) have only an outer annuli, which contains two annulus conductivity probes.

The major components of the Waste Tank Annulus Conductivity Probes and High Level Alarms include a stainless steel sensing probe, aircraft cable/wiring, level sensing relay, and control room panel alarm/annunciator. Power supplies to the sensing circuit and annunciator, and the functional test switch are not within the SS boundary. See Figure 4.3-2.

All active and passive components that comprise the sensing and instrumentation circuit are considered SS components. These components include but are not limited to the signal cable, grounding pathway, terminal blocks, cable connectors, sensing relays, alarm relays, alarm bistables, and annunciators.

4.4.28.3 System Evaluation

Functionality is assured through the implementation of applicable SRs, as identified in the TSRs.

The associated section of Table 4.4-2 summarizes the DR evaluation for the Waste Tank Annulus Conductivity Probes and High Level Alarms. Though the DR evaluation was

performed specifically for Type III/IIIA Waste Tanks, the design elements utilized in the evaluation are also present for Type I/II Waste Tanks. The evaluation can therefore be applied to Type I/II Waste Tanks. A general assessment of the applicable DRs is provided.

DR-3 Functionality

The Annulus Conductivity Probes and High Level Alarms have demonstrated a high degree of reliability to perform their credited function. However, there are vulnerabilities in the system, such as failure during a loss of power, loss of input signal or failure of the level sensing relay/circuit. Based on the reasons/discussions stated below, Waste Tank Annulus Conductivity Probes and High Level Alarms are deemed acceptable to meet their SS FC requirements.

- The Instrument Loop periodic testing provides assurance that power is available and that the entire loop including the applicable panel alarm, is functioning properly when the tests are accomplished. The likelihood of relay failure or losing power during the period between these surveillances and at the same time having an event that leaks waste into a tank annulus is highly unlikely.

- A total loss of power resulting in a loss of lighting, multiple indications, and loss of control room instruments will be obvious to operators such that corrective action may be taken. Only a loss of power or electrical signal to a very selective circuit(s) might go undetected.

- A failure of the level sensing relay/control room alarm could result from sticking contacts, an electrical short, or loss of the electrical circuit. Because each annulus has multiple instruments, it is considered unlikely that the instruments would all fail at the same time that an annulus leak occurs. Several annulus conductivity probes do share control room alarm modules, however the periodic functional verifications of the instrument loop would detect a failed alarm module.

5.5.2.5 Annulus Level/Ventilation (Limiting Condition for Operation 3.8.5)

Chapter 3 credits the waste storage tank annulus fill level for protecting the initial hydrogen concentration used in the tank annulus explosion scenario (Section 3.4.2.12). Because of the ductwork in the Type I and Type II annuli, visual verification of any level below the top of the ventilation duct (21 inches and 23 inches, respectively) can not be achieved. For this reason, the initial annulus level is 21 inches in Type I tanks and 23 inches in Type II tanks. If a bounding hydrogen generation rate for sludge is used, equilibrium hydrogen concentration in the annulus vapor space would exceed 25% of the LFL. In order to maintain the initial 25% LFL used in the annulus explosion calculation, a lower inhalation dose potential (lower hydrogen generation rate) and periodic ventilation system operation are required.

This LCO requires that the annulus fill level be less than, or equal to, the residual volume as provided in Table 3.4-3 for each waste tank type and that forced ventilation be operated (Type I and II tanks) on a sufficient basis and duration to maintain the annulus vapor space hydrogen concentration less than, or equal to, 25% of the LFL. Because this LCO is protecting an initial condition assumption in Chapter 3 (i.e., initial hydrogen concentration), leak detection instrumentation ~~no equipment~~ operability is specified within this LCO. Therefore, this LCO requires that annulus leak detection instrumentation (i.e., conductivity probe) be operable when needed to monitor the annulus level~~.~~ (Reference XXX). ~~-~~This LCO is required for Waste Tanks 1 through 15, 25 through 47, and 49 through 51 in any of the defined waste tank Modes. Note that the lower hydrogen generation rate for the Type I and Type II tanks is controlled via the ~~Type I, II, and IV Waste Tank~~ Hydrogen Generation Rate Control AC Program.

In the event that the annulus level is discovered to be greater than the volume provided in Table 3.4-3 or the forced ventilation has not operated as required on a Type I or Type II annulus, actions shall be taken to immediately secure transfers through the affected annulus and to ensure that the affected annulus is receiving forced ventilation flow (installed or portable) prior to reaching flammable conditions (100% of LFL). The ventilation requirements when jetting tank annuli contents is governed by an AC (Transfers From Waste Tank Annuli).

As part of restoring the level within the values of Table 3.4-3, continuous purge shall be supplied to the affected tank annulus for a sufficient duration to perform the necessary number of vapor space turnovers to "reset" the vapor space hydrogen concentration to the conditions used in the residual analysis (i.e., flammable concentration is less than, or equal to, 7% of the hydrogen LFL). From Reference 17, the number of vapor space turnovers required to "reset" the vapor space is 12, assuming a conservatively low mixing fraction of 0.25.

In the event that the annulus leak detection instrumentation is inoperable when needed to monitor annulus level, actions shall be taken to verify that the level is less than or equal to the volumes provided in Table 3.4.3. This action shall be completed prior to reaching flammable conditions within the annulus (100% of LFL).

5.5.2.5.1 VERIFICATION OF ANNULUS LEVEL (SURVEILLANCE REQUIREMENT 4.8.5.1)

The annulus level ensures that the initial hydrogen concentration is within the analyzed value. Since this LCO requires a maximum level for the waste tank annuli, verification on a routine basis is required. Additionally, this SR is used to protect the assumption that primary tank leakage into the annulus is identified soon enough to ensure mitigative actions are taken prior to the annulus reaching 100% LFL. This detection is not needed for the seismic initiated leakage scenario since the seismic event itself initiates action to check the annulus and take mitigative actions. An operable annulus conductivity probe shall be used to perform this SR.

The unmitigated scenario in Section 3.4.2.12 assumed a primary tank leak was detected by the time the leaked waste reached the "residual" level, then the leak continued at the same rate for 10 more days. The 10 days was chosen to conservatively cover all initiators of leakage into the annulus, including a seismic event. For the non-seismic initiated primary tank leak, responding to a leaking tank, once detected in the annulus, would be much shorter. Using the assumptions in Section 3.4.2.12, the vapor space in the annulus for the non-seismic initiated primary tank leak scenario was only ~60% LFL (Reference 39). For the Type III and IIIA tanks, the residual level is reached in approximately four days (assuming an empty annulus and a maximum non-seismic leak rate of 0.4 gpm). However, Type III and IIIA tanks have never leaked, have no known leak sites, were constructed using post-weld heat treatment, and are maintained by the corrosion control and structural integrity programs. The 0.4 gpm was conservatively used in the unmitigated calculation for convenience to be consistent with the analysis for Type I and II tanks. However, the 0.4 gpm is very conservative for Type III/IIIA tanks. For the Type I and II tanks, the residual levels are reached in approximately fourteen days (assuming an empty annulus and a maximum non-seismic leak rate of 0.4 gpm). The corrosion control and structural integrity programs also cover these tanks, but some are known to contain various leak sites. Finally, there are uncredited features in place most of the time to detect primary tank leakage into the annulus other than the periodic verifications dictated by this SR (e.g., ~~annulus conductivity probes,~~ annulus level dip tubes, annulus exhaust ventilation Continuous Air Monitors, reel tapes measuring primary tank level).

Based on all the considerations above, a 7 day surveillance frequency is more than adequate to detect primary tank leakage in sufficient time to ensure mitigative actions are taken prior to the annulus reaching 100% LFL.

5.5.2.5.2 TYPE I AND TYPE II ANNULUS VENTILATION OPERATION (SURVEILLANCE REQUIREMENT 4.8.5.2)

Because annulus ventilation is required in conjunction with annulus level in the Type I and II tanks, operation on a periodic basis is required. This surveillance is met by operating the annulus ventilation for a sufficient duration to achieve 12 vapor space turnovers. The frequency of the surveillance shall be sufficient to ensure that even in the case that an annulus is filled to the allowed level with waste, that the peak hydrogen concentration in the annulus will not exceed 25% of the LFL. The hydrogen generation rates for the Type I and Type II tanks are protected by an AC (Type I, II, and IV Waste Tank Hydrogen Generation Rate AC Program).

5.5.2.5.3 INSTRUMENT LOOP TEST OF ANNULUS CONDUCTIVITY PROBE (SURVEILLANCE REQUIREMENT 4.8.5.3)

Performance of an instrument loop test on each required conductivity probe ensures that the instruments are capable of detecting a high level condition and annunciating in the applicable control room. The instrument loop test verifies the operability of the entire instrument loop (e.g., conductivity probe and associated circuitry and control room alarms) with the exception of a limited portion of the common return path encompassing the grounding scheme. This SR shall be performed on a routine basis to ensure that the conductivity probes are maintained for use in performing Surveillance Requirement 4.8.5.1.

5.5.2.5.4 VERIFICATION OF ANNULUS CONDUCTIVITY PROBE HEIGHT (SURVEILLANCE REQUIREMENT 4.8.5.4)

The annulus conductivity probe setpoint ensures that the annulus volume is within analyzed limits. Therefore, the annulus conductivity probe shall be verified to be installed at, or below, the residual height given in Table 3.4-3 (including uncertainty). The frequency of this surveillance shall be based on operational experience and engineering judgment and considered adequate to monitor adverse trends in instrumentation performance.

Table 5.9-1

Secondary Containment Waste Control (Waste Tank Annulus Level/Ventilation) * Annulus conductivity probes are required for SR for annulus level and are classified as SS	NA*	Sec. 3.4.1.5.6 Sec. 3.4.2.12 Sec. 4.4.28 * Table 3.4-3	LCO 3.8.5
Type III/IIIA Waste Tank Annulus Leak Detection	SS	Sec. 3.4.2.9 Sec. 4.4.28 Table 3.3-15	LCO 3.8.6

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

MAR 14 2003

Mr. Robert A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 1

References:
1. Letters, Johnson to Anderson, CBU-2003-00028, 2/20/03; and CBU 2003-00034, 3/4/03
2. My Letter, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) for the 10CFR830 Compliant Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR's)," PC-03-008, 12/20/02

The Department of Energy (DOE) Savannah River Operations Office (SR) has evaluated the safety basis document changes submitted in Reference 1. DOE-SR approves these safety basis documents. The enclosed SER Revision 0, Supplement 1, documents the basis for approval. DOE-SR identified one Revision Issue (CSTF-0-1-R1), discussed in Section 5.3 of the enclosed SER supplement, which is required to be resolved no later than the first annual update of the CSTF Documented Safety Analysis (WSRC-SA-2002-00007).

You are requested to take action to add the submitted safety basis document changes into the safety basis defined in the High Level Waste Division Authorization Basis Manual (WSRC-IM-94-10) upon implementation of the changes. As discussed in Reference 2, a revision to the Authorization Agreement for the CSTF (WSRC-RP-2001-00154) must be submitted to me for approval prior to making these safety basis documents effective. Additionally, you are expected to pursue revising the Removed From Service mode criteria such that entry into this mode would not require DOE-SR approval. For example, the criteria should address multiple tanks placed in the Removed From Service mode. These actions have been discussed with Dave Little of your staff.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or your staff may contact Tom Temple at 208-8772.

Sincerely,

Jeffrey M. Allison
Acting Manager

PC-03-018

Enclosure:
CSTF SER, Rev. 0 Supplement 1

cc w/encl:
W. J. Johnson, WSRC, 703-H
D. B. Little, WSRC, 703-H

cc w/o encl:
H. T. Conner, Jr., WSRC, 703-A
L. J. Hollick, WSRC, 703-A
W. S. Elkins, WSRC, 730-B
V. G. Dickert, WSRC, 703-H
W. T. Davis, WSRC, 707-H

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 1

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 0,
Change Request Package HLW-CRF-03005, Rev. 1

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 1 DOE Approval

AND

CSTF JUSTIFICATION FOR CONTINUED OPERATION,

WSRC-TR-2003-00083, Revision 0

March 2003

Prepared by : Thomas C Temple
Thomas C. Temple

Reviewed by: Donald J. Blake
Donald J. Blake

Approved by:
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR HIGH LEVEL WASTE
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 1

Executive Summary

The CSTF Documented Safety Analysis and Technical Safety Requirements compliant with 10CFR830, Subpart B, were approved by DOE via SER Revision 0 issued December 20, 2002. Since then, several changes to the Documented Safety Analysis and Technical Safety Requirements were identified as necessary to support implementation. Briefly, these changes fall into the following categories:

1. Defining a Removed From Service Mode for waste tanks.
2. Revising the number of waste tanks allowed to reach the lower flammability limit in less than 24 hours and less than 7 days.
3. Incorporating applicable details from the previous approved safety basis document (WSRC-SA-15) to show Tank 48H (former In-Tank Precipitation tank) is safe from a criticality perspective.
4. Adding HDB-1 to the list of Process Areas that are inactive and prohibited from waste processing activities.
5. Addition of reference/discussion of revised Tank 41H Nuclear Criticality Safety Evaluation.
6. Other miscellaneous clarifications and editorial corrections.

Additionally, the discovery of solids in Tank 50H resulted in a Discovery Unreviewed Safety Question being declared on February 5, 2003 due to the potential impact from these solids on retaining higher than expected amounts of benzene/benzene producing material. Changes made to the previous safety basis were submitted to DOE and approved by DOE in February 2003 to allow removal of these solids; however, this effort is not forecasted to be complete prior to implementation of the 10CFR830-compliant CSTF Documented Safety Analysis and Technical Safety Requirements. The new CSTF Documented Safety Analysis and Technical Safety Requirements require the material in Tank 50H to be sufficiently low in organics/organic producing material so as not to impact the Lower Flammability Limit by more than 5%. Thus, to support implementation of the new Documented Safety Analysis and Technical Safety Requirements, a Justification for Continued Operation was developed to allow the continued removal of the solids in Tank 50H to the Saltstone Facility such that the 5% Lower Flammability Limit allowance can be met.

The specific safety basis documents submitted for review and approval are:

1. Change Request Package HLW-CRF-03005, Rev. 1 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
2. CSTF TSRs, S-TSR-G-00001, Revision 1 DOE Approval (1DA1)
3. CSTF JCO, WSRC-TR-2003-00083, Revision 0

Based on the evaluation documented in this SER supplement, DOE review of the safety basis changes above concludes the hazards associated with the Design Basis Accidents have been identified and the appropriate safety basis controls applied to protect the onsite workers, the general public, and the environment. No Conditions of Approval are identified within this SER supplement. Therefore, the proposed changes submitted are approved. DOE identified one Revision Issue (CSTF-0-1-R1), discussed in section 5.3, which is required to be addressed no later than the next annual update of the DSA.

1.0 Introduction

The CSTF Documented Safety Analysis (DSA) and Technical Safety Requirements (TSRs) compliant with 10CFR830, Subpart B, were approved by DOE via SER Revision 0 issued December 20, 2002 (Reference 1). Since then, several changes to the DSA and TSRs were identified as necessary to support implementation. The major changes involved:

1. Defining a Mode (Removed From Service) which allows a waste tank to be excluded from safety basis controls other than the Sitewide Programs given in DSA section 3.3.3.3.2.
2. Revising the number of waste tanks allowed to reach the lower flammability limit (LFL) in less than 24 hours and less than 7 days.
3. Incorporating applicable details from the previous approved safety basis document (WSRC-SA-15) to show Tank 48H (former In-Tank Precipitation tank) is safe from a criticality perspective.
4. Adding HDB-1 to the list of Process Areas that are inactive and prohibited from waste processing activities.
5. Addition of reference/discussion of revised Tank 41H Nuclear Criticality Safety Evaluation (NCSE).
6. Other miscellaneous clarifications and editorial corrections.

Additionally, the discovery of solids in Tank 50H resulted in a Discovery Unreviewed Safety Question (USQ) being declared on February 5, 2003 (Reference 2) due to the potential impact from these solids on retaining higher than expected amounts of benzene/benzene producing material. Changes made to the previous safety basis were submitted to DOE and approved by DOE in Reference 3 to allow removal of these solids; however, this effort is not forecasted to be complete prior to implementation of the 10CFR830-compliant DSA and TSRs. The new CSTF DSA and TSRs require the material in Tank 50H to be sufficiently low in organics/organic producing material so as not to impact the Lower Flammability Limit (LFL) by more than 5%. Thus, to support implementation of the new DSA and TSRs, a Justification for Continued Operation (JCO) was developed to allow the continued removal of the solids in Tank 50H to the Saltstone Facility such that the 5% LFL limit can be met. Once this occurs, the JCO will be removed from the CSTF safety basis and Tank 50H will be controlled and operated as all the other "non-organic" waste tanks within the CSTF.

The specific safety basis document changes proposed are listed in the WSRC submittal (References 4 and 5). The safety basis document changes submitted are:

1. Change Request Package HLW-CRF-03005, Rev. 1 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
2. CSTF TSRs, S-TSR-G-00001, Revision 1 DOE Approval (1DA1)
3. CSTF JCO, WSRC-TR-2003-00083, Revision 0

2.0 Background

The submitted changes to the safety basis in References 4 and 5 do not alter the purpose, mission, or Hazard Category of the CSTF. DOE CSTF SER Revision 0 (Reference 1) remains applicable for these topics. The solids in Tank 50H represent another mechanism to initiate an explosion for which the controls within the DSA and TSRs approved in Reference 1 are not adequate. Thus, the JCO was developed to allow removal of these solids such that the DSA/TSR analyses and controls are viable for Tank 50H.

3.0 Review Process

WSRC initially submitted the safety basis changes to support DSA/TSR implementation in Reference 4. DOE review of these changes identified several areas requiring correction and clarification. WSRC submitted page changes to address these corrections and clarifications in Reference 5. The DOE review documented in this SER supplement (Supplement 1) reflect the composite page changes between References 4 and 5.

This SER supplement (Supplement 1) is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

4.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, and the various DSA sections were consistent. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 (Reference 1) were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs: (1) are clear with respect to process area applicability; (2) provide adequate justification to support Limiting Conditions for Operation (LCO) conditions, actions and surveillance requirements; (3) provide clear administrative controls; and (4) are consistent with the accident descriptions and credited controls.

The JCO was reviewed to ensure it provided the necessary and sufficient controls to support solids removal from Tank 50H. Since the activity is continuing an activity begun under the previous safety basis document, this SER supplement (Supplement 1) ensured the applicable controls reviewed and approved by DOE (Reference 3) were maintained.

5.0 Evaluation

Each of the seven major changes identified in Section 1.0 above was evaluated using the criteria established in Section 4.0 above. The results of these evaluations are provided here.

5.1 Removed From Service Mode

The DSA and TSRs were revised to create a mode (Removed From Service (RFS) Mode) in which a waste tank could be removed from specific safety basis controls. To justify entering this mode, the following conditions have to be met:

1. stored waste has total effective inhalation dose potential $\leq$ 1.0E+12 rem
2. waste tank must be classified as a Very Slow Tank, including a reduction of 100,000 gallons of vapor space (accounts for minor water additions (see item 9 below) and rain water intrusion)
3. waste tank vapor space cannot reach 100% LFL post-earthquake; again vapor space used for calculation includes a reduction of 100,000 gallons of vapor space (accounts for minor water additions (see item 9 below) and rain water intrusion)
4. certain transfer line segments shall be placed out of service (to isolate the tank)
   a. segments into and out of tank and annulus
   b. segments for which the secondary containment overflows or drains to the tank
5. bearing water supply to pumps in the tank and cooling water supply/return to the tank (cooling coils and purge exhaust condenser) shall be blanked
6. air and steam supply to any primary or annulus transfer jet shall be blanked
7. waste transfers into and out of tank are prohibited
8. operation of slurry pumps/mixers is prohibited and air supply to the pumps/mixers must be isolated
9. liquid additions are limited to those necessary for:
   a. flushing equipment as part of removal/installation
   b. tank chemistry for corrosion control
   c. maintaining ballast water
   d. preventing drying out of exposed solids on the floor of the tank
   e. achieving waste immobilization for permanent closure (e.g., grouting).
10. WSRC and DOE approval obtained for entry into the RFS Mode.

The basis for the conditions above is to ensure that the hazards postulated to occur associated with waste tanks have been eliminated or the consequences have been reduced to well below the applicable Evaluation Guidelines (EGs), see the table below. Once the conditions above are met, a waste tank can be placed in the RFS Mode. The result of this action is that controls directly applicable to waste tanks and associated equipment are not required. Therefore, administrative control programs such as Corrosion Controls, Structural Integrity, Sludge Carryover Minimization, Transfers from Waste Tank Annuli, Flammable Vapor Sampling Monitoring, Pump Run, etc. are no longer applicable to these tanks. Likewise, equipment and associated TSR Limiting Conditions for Operation (LCOs) for tank ventilation, tank Lower Flammability Limit (LFL) monitoring, High Liquid Level Conductivity Probe, etc. are no longer applicable to these tanks. However, the Sitewide safety programs such as Radiological Protection, Emergency Response, Quality Assurance, Industrial Hygiene, etc. discussed in DSA section 3.3.3.3.2 are still applicable for activities associated with tanks placed in the RFS Mode.

DOE reviewed the basis for the 1E+12 rem condition above, which is found in calculation S-CLC-F-00448. This calculation determined the consequences of a tank top collapse in a tank where the total material inhalation dose potential had been reduced to 1E+12 rem. This calculation is actually used for two separate purposes. One is to show the offsite and onsite consequences if a tank which has entered the RFS Mode fails. The other is to show the offsite consequences of a Type IV tank top collapse, even if not in the RFS Mode, because Type IV tanks are not safety class (thus their

confinement function cannot be credited for protecting offsite receptors). Both of these cases are discussed in the revised DSA section 3.4.2.14, Waste Tank Wall Failure, which postulates a failure of a waste tank side wall and/or tank top. The calculation used the same general inputs and methodologies employed in the consequence calculations referenced in the DSA reviewed by DOE in Reference 1 (e.g., used the MACCS code, used the bounding supernate and bounding sludge slurry source terms, used the same 3-minute and 8 hour dose conversion factors, used the same tank volumes, etc.). Calculation S-CLC-F-00448 conservatively assumed the entire 1E+12 rem is subjected to the airborne release fraction (ARF) and respirable fraction (RF) applicable to a three meter spill since this 1E+12 rem could be in any volume. DOE reviewed this calculation and found it to be conservative (e.g., no filtering assumed - LPF of 1.0; assumed an ARF/RF value for aqueous solutions for the spill of thick slurry (16.7wt% solids)), and the results supportable from the inputs and methods. DOE checked the math using the inputs and formulas for the 100m case at 1E+12 rem. DOE also compared the results to those in previously reviewed calculation S-CLC-G-00236 (in Reference 1), which evaluated spilling 15,000 gallons of waste from 3 meters inside boxes, cells, etc. Using simple ratios of the ARF/RF employed and the different waste volumes released, DOE confirmed the results in calculation S-CLC-F-00448 were consistent. The resulting worst case doses for an individual tank top collapse (either a waste tank placed in the RFS Mode or a Type IV waste tank) were 26 rem at 100 meters and < 0.5 rem offsite. The doses are well below the 100 rem onsite and 25 rem offsite EGs for this specific design basis accident (DBA).

DOE evaluated the DBAs in the DSA requiring controls for waste tanks as shown in the following table:

DBA Section	Event	Possible in RFS Mode	Justification
3.4.2.9	Waste Tank Overflow	No	Tank is isolated from liquid sources (only limited, small liquid additions permitted). Since the tank must meet the Very Slow Tank category, even with an additional 100,000 gallons of water added, this ensures adequate vapor space to avoid overflowing. Additionally, the definition of Removed From Service Mode (see discussion below) requires DOE approval before entering the Mode. This will ensure the waste has been sufficiently removed from the waste tank such that overflow is incredible.
	Waste Tank Annulus Overflow	No	Lines traversing annulus must be isolated
3.4.2.10	Transfer Jet Aerosolization	No	Steam supply must be isolated to jet
	Slurry Pump/Mixer Aerosolization from rooster tailing	No	Pump/Mixer operation prohibited
	Waste Tank Annulus Aerosolization during Annulus Transfer Jet Operation	No	Steam supply must be isolated to jet
	ADMP Aerosolization due to air leak	No	Air supply must be isolated to pump
	Dry Sludge Tank Aerosolization	No	Existing control to prevent formation of additional dry sludge tanks
3.4.2.11	Waste Tank Explosion	No	To enter RFS Mode, tank must be categorized as Very Slow, accounting for extra 100,000 gallons of liquid addition

DBA Section	Event	Possible in RFS Mode	Justification
3.4.2.12	Waste Tank Annulus Explosion due to leakage from traversing transfer line	No	Lines traversing annulus must be isolated
	Waste Tank Annulus Explosion due to leakage from primary tank wall	No	Limited volume (see discussion below), limited source term (1E+12 rem), and the fact that the material must ensure the primary tank does not reach 100% LFL (i.e., meets Very Slow Tank category) ensures leaks into the annulus will not reach LFL.
	Underliner/Sidewall sump explosion	Yes	Consequences, with 1E+12 rem limit, are well below EGs
3.4.2.14	Waste Tank Wall Failure (includes Type IV tank top collapse)	Yes	The SB will not specifically require the tanks placed in the RFS Mode to be SC or SS. Thus, seismic qualification is not required once entering into this mode. Consequences due to tank wall failure, with 1E+12 rem limit, are well below EGs (discussed above). The design process within the Site Manual E7 ensures that overloading the tank top will be prevented. Additionally, with the limited volume (see discussion below), the hazard in the tank has been removed to the maximum extent possible.
3.4.2.15	Siphon/Pump Out through failed cooling coils	No	Cooling coils must be isolated
3.4.2.17 thru .20	All of the above events initiated by NPH events and Loss of Offsite Power	Yes	For Seismic, to enter RFS Mode, tank must be shown to not reach 100% LFL post earthquake due to trapped gas release See discussion below for justification due to tank integrity failure.

The intent of the RFS Mode is to recognize that once a waste tank has had its waste removed to the point where it is ready for permanent closure (e.g., grouting), specific safety basis controls are no longer required to be applied since the hazard has been removed to the maximum extent possible (typically this results in a remaining heel of < 10's of thousands of gallons). The definition of the Removed From Service Mode requires DOE approval prior to entering into this Mode. Thus, DOE approval (via an SER supplement) will ensure that the tank meets both the 1E+12 rem limit and is ready for permanent tank closure (e.g., grouting) prior to entering the RFS Mode. This will ensure that the tank will not enter the RFS Mode prematurely (which allows tank specific equipment and administrative controls to be removed) then subsequently need to exit the RFS Mode in order to remove more waste. Additionally, once the conditions to enter the RFS Mode are met, standard design, operational, and the Sitewide safety programs described in section 3.3.3.3.2 of the CSTF DSA are adequate and no specific safety class or safety significant controls are warranted.

Section 3.4.2.18, Seismic Event, of the DSA was modified to reflect the revised cumulative dose from an earthquake to address tanks which have been placed in the RFS Mode. As discussed above, once a waste tank has entered the RFS Mode, the waste tank is not considered to be safety class (SC) or safety significant (SS) and the tank-specific SC and SS controls no longer apply. Thus, from the time the tank is placed in the RFS Mode until the tank is actually closed (grouted), the material left in the tank could be impacted since the tank could fail due to an earthquake. Section 3.4.2.18 discusses this possibility and refers to calculation S-CLC-F-00448 to show the maximum consequence from this tank failure would be 26 rem at 100 meters.

Excluding the pump tank and waste tank explosions (reviewed and accepted in DOE SER Revision 0 (Reference 1)), the current cumulative onsite (100m) dose from a Seismic Event is ~75 rem. However, this is simply a summation of the doses from all the potential individual events postulated to occur from the Seismic Event, and does not account for the layout of the facility (i.e., an onsite individual cannot be exposed to each of these individual events since there is no one location that is ≤ 100 meters away from each of the hazards). For example, ~24 rem of this 75 rem is from an over-pressure event in the 242-25H Evaporator and ~28 rem is from a pump tank overflow. Given the layout of the H-Tank Farm, for any given wind direction, there is no exposure point ~100 meters from the 242-25H Evaporator and a pump tank.

To account for the additional 26 rem from a potential tank top collapse from a waste tank placed in the RFS Mode, WSRC assessed the CSTF layout. WSRC prepared an evaluation (Reference 6), which was added as a reference in DSA section 3.4.2.18.4, to show that an onsite individual would not be exposed to all the possible releases post-earthquake simultaneously. DOE, likewise, reviewed the layout of the CSTF and the postulated post-seismic releases given in DSA section 3.4.2.18.4 (excluding, as discussed above, the pump tank and waste tank explosions), and determined that a conservative estimate of onsite (100m) dose would be ~80 rem (and this would only occur in locations SW of 242-16F Evaporator, NE of FPT-2/3, S/SW of 242-16H Evaporator, and N/NE of HPT-5/6, depending on wind direction), which is judged to not challenge the onsite EG. Thus, even though the cumulative addition of individual doses shown in DSA section 3.4.2.18.4 is 101 rem, the more credible dose is ~80 rem (excluding pump tank and waste tank explosions). Based on this and the conservatisms in the analyses (discussed in Reference 6), DOE concluded the onsite post-earthquake dose has been reduced to an acceptable level.

Section 3.4.2.18 only considers the consequences from one tank failing due to being in the RFS Mode. DOE review and approval prior to placing each tank in the RFS Mode (via an SER supplement) will evaluate the cumulative effect of all the tanks in the RFS Mode. For example, placing two tanks located next to each other in the RFS Mode could cause the onsite receptor 100 meters away to receive 52 rem (2*26 rem/tank). If this receptor location was not susceptible to pump tank events and/or evaporator events, this could still be shown acceptable. Likewise, if multiple tanks were placed in the RFS Mode, but each tank was >> 100 meters apart from each other, then this could also be justifiable. Thus, the DOE review and approval will evaluate the number and location of the tanks placed in the RFS Mode to ensure the estimated 80 rem maximum onsite exposure (discussed above) is not invalidated.

DOE review of the proposed changes found sections 3.4.2.14 and 3.4.2.18 of the DSA consistent with the supporting calculation (S-CLC-F-00448), found all the DSA sections modified (e.g., Executive Summary, Chapters 3, 4, and 5) to be internally consistent and compliant with the criteria in DOE-STD-3009, and found the TSR revisions to be internally consistent, consistent with the derivation in the DSA, and compliant with the criteria in DOE Guide G 423.1-1.

5.2 Number of waste tanks that are allowed to reach LFL in less than 24 hours and less than 7 days

Revision 0 of the DSA and TSRs approved by DOE in Reference 1 recognized that the potential existed for some tanks to reach/exceed 100% LFL post-earthquake due to the potential for trapped hydrogen within the waste (sludge and salt) to be suddenly released due to the seismic motion. This potential result occurs because the ventilation systems on the waste tanks are not seismically qualified safety class systems. Chapters 3 and 4 of the DSA recognize this vulnerability and committed to controlling CSTF operations such that only tanks 27F, 32H, 43H, and 44F would be

allowed to reach 100% LFL post-earthquake in < 24 hours and only these four tanks plus tanks 26F, 33F, 35H, 39H, and 49H would be allowed to reach 100% LFL post-earthquake in < 7 days. For some of the tanks not on this list, the result of these two commitments would be to lower the allowable liquid level in the tanks such that at least 7 days post-earthquake would exist. Especially for Type III and IIIA tanks (full secondary containment compliant with DOE Order O 435.1A), this could result in a loss of useable tank space for future processing needs. The analysis that was performed to derive this listing of tanks (WSRC-TR-2002-00137, issued in April 2002) was not fully consistent with the final methodologies for determining the time to reach LFL in the DSA (final approved version submitted to DOE in November 2002). Additionally, assessing the future operational needs of the CSTF to support the accelerated closure goals of HLW tanks led to a re-assessment of which tanks should be allowed to reach 100% LFL post-earthquake. Various cases were run to determine the sensitivity of the parameters involved to determine the post-earthquake time to reach 100% LFL. Additionally, the number of tanks that could reach 100% LFL post-earthquake drive additional minimum staffing, so there is a practical limitation consideration. Based on these considerations, the proposed DSA/TSR changes submitted in References 4 and 5 were to:

1. Change the < 24 hour category from four specific tanks to a commitment to limit the total number of tanks allowed to reach/exceed 100% LFL post-earthquake to 7.
2. Change the < 7 day category from nine specific tanks to a commitment to limit the total number of tanks allowed to reach/exceed 100% LFL post-earthquake to 14.
3. Clarify that the determination of the time to reach 100% LFL post-earthquake is based on actual tank liquid/waste level, not the High Liquid Level Conductivity Probe (HLLCP) setpoint (i.e., the HLLCP is not credited for protecting the post-earthquake time to reach 100% LFL).
   [*This is appropriate to ensure the tanks which actually have short times to reach LFL are identified such that Operations knows the prioritization of which tanks to establish ventilation to prevent an explosion.*]
4. Revised DSA section 5.5.5 and TSR Administrative Control section 5.2.2 to change the minimum shift crew size from 9 to 11 operators (in H-Tank Farm) and from 6 to 7 operators (in F-Tank Farm).
   [*As discussed in HLW-CST-02-002, revision 3, referenced in DSA section 5.5.5, this is based on having 4 tanks in H-Tank Farm and 3 tanks in F-Tank Farm which could reach 100% LFL in less than 24 hours. Based on current and projected tank waste levels, this is adequate. It is DOE's understanding that, if the number of tanks in either tank farm exceed their individual allotment (i.e., > 4 in H-Tank Farm or > 3 in F-Tank Farm, even if total is still ≤ 7), DSA section 5.5.5 and the accompanying TSR AC 5.2.2 would have to be revised and submitted to DOE for approval.*]

The basis for DOE approval of the original commitments to limit the < 24 hour category to 4 specific tanks and the < 7 day category to 9 specific tanks is given in DOE CSTF SER Revision 0 (Reference 1) and repeated here:

1. the low likelihood of experiencing a major earthquake;
2. the expected conservatism in the assumed earthquake's ability to cause trapped gas to be released;
3. the DSA/TSR commitment to maintain sufficient portable ventilation units to respond quickly to re-establish ventilation on these tanks;
4. the fact that, should an explosion occur in one of these waste tanks, the material at risk would be the supernate, versus the much higher dose potential from sludge slurry; and

5. the ability of the Emergency Response Organization to ensure timely evacuation of onsite and offsite personnel from the plume pathway

DOE reviewed the proposed changes to increase the total number of tanks and eliminate the specific tank designations and concluded that, given: (a) the DSA already requires the number of portable ventilation units to equal the number of tanks which could reach 100% LFL post-earthquake + a sufficient number to accommodate those additional tanks less than 7 days; and (b) the increased minimum staff size, this proposed change is acceptable and does not significantly increase the risk DOE accepted in Reference 1. Additionally, by eliminating specific tank designations, operational flexibility is provided without any increase in risk.

DOE review of the proposed changes found all the DSA sections modified (e.g., Chapters 3 and 5) to be internally consistent and compliant with the criteria in DOE-STD-3009, and found the TSR revisions to be internally consistent, consistent with the derivation in the DSA, and compliant with the criteria in DOE Guide G 423.1-1.

5.3 Tank 48H Criticality

Tank 48H, formerly the reaction tank for the In-Tank Precipitation (ITP) process, was treated differently in the 10CFR830-compliant DSA and TSRs from the other HLW tanks within the CSTF since it was the only tank within the CSTF which would contain significant benzene producing waste at the time the DSA and TSRs were implemented (see Section 5.4 for subsequently identified issue on Tank 50H). Thus, to ensure the benzene hazard was confined to Tank 48H, the DSA and TSRs require Tank 48H to be isolated from all other CSTF process areas. Until an adequate treatment process is developed and implemented for the material within Tank 48H, this tank is required to remain in this isolated state. Given this, some of the accident analyses for Tank 48H were not upgraded to be consistent with the analyses for the other HLW tanks, but rather the approved analyses from the previous safety basis (WSRC-SA-15) were carried into the new DSA/TSRs as-is. Section II.F of the DOE CSTF SER Revision 0 (Reference 1) specifically discusses this topic. However, in the translation from the previous safety basis (WSRC-SA-15) to the new DSA (WSRC-SA-2002-00007), the criticality safety basis for the waste material in Tank 48H (from section 4.3.3 in WSRC-SA-15) was not carried forward into Chapter 6 of the new DSA. This Change Request (HLW-CRF-03005), submitted in References 4 and 5, revises Chapter 6 to include the pertinent information to show the material in Tank 48H does not represent a criticality concern. DOE has previously reviewed the basis (WSRC-TR-93-171, WSRC-TR-94-004, WSRC-TR-95-0348, and HLW-REG-950209) to support the previous safety basis document (WSRC-SA-15) in Reference 7 and most recently Reference 8, which is now captured in the new DSA chapter 6. Since this SER (CSTF SER, Revision 0, Supplement 1) supersedes References 7 and 8, the basis is repeated here.

Monosodium titanate (MST) was added to Tank 48H during the 1983 ITP process demonstration and during 1995 Batch 1 ITP processing to adsorb strontium, but it also adsorbs fissile materials like uranium and plutonium. However, the physical limitations of the adsorption process were found to be (through experiments in the lab) such that criticality was not a concern because an insufficient amount of fissile material could adsorb onto the MST to accumulate sufficient quantity to achieve a criticality. Chapter 6 of the DSA was revised via Change Request HLW-CRF-03005 to state that Tank 48H contains ~1100 kg of MST and that it would require >100,000 kg (71 additions at 1500 kg per addition) of MST before sufficient mass accumulated to achieve a criticality. DOE reviewed the references given in DSA chapter 6 and found that these numerical values were not

correct. Through review of these same references, sources to these references, as well as more recent reports, DOE concluded that Tank 48H was safe from a criticality perspective by the same general argument as proposed in References 4 and 5, but that the DSA needed to be revised to reflect the accurate bases (discussed following the Revision Issue). Therefore, DOE identified the following Revision Issue:

CSTF-0-1-R1: Revise DSA section 6.4.1 to reflect the accurate mass of MST in Tank 48H and the basis for criticality safety consistent with the approach in SRT-LWP-2002-00112. [*Revision Issue*]

The total amount of MST in Tank 48H from the 1983 and 1995 additions is estimated to be < 2500 kg (SRT-LWP-2002-00112) and no further additions of MST are allowed per the DSA and TSRs. The amount of MST (with fissile material adsorbed on the MST) necessary to accumulate sufficient fissile material to represent a criticality concern (under spherical and optimum moderation and fully reflected conditions) is >10,000 kg (even if the equivalent U^{235} wt% is 100%, see WSRC-TR-94-004). Reports WSRC-TR-93-171, WSRC-TR-94-004, and HLW-HLE-96-0159 document that the waste in Tank 48H is well below an equivalent U^{235} wt% of 100%. Additionally, WER-WME-920788 (NCSA WM-92-1) documents that an equivalent U^{235} loading on MST of $\leq$ 1.96 wt% is infinitely safe regardless of the quantity of MST. Report SRT-LWP-2002-00112 shows that the fissile isotopes of Uranium and Plutonium compared to MST is <0.8 wt%. Thus, ample margin exists to show the Tank 48H waste does not represent a criticality concern.

Additionally, tetraphenylborate (TPB), added to remove radioactive Cesium, can cause plutonium particles to be removed from solution and captured within the TPB precipitate, which can float to the surface of the waste or settle to the bottom, depending on the specific gravity of the waste material. In either case, the resulting areal density and concentration of fissile material are well below the criticality limits of 0.25 gram/cm^2 and 7.3 gram/liter.

5.4 Tank 50H Solids Removal

Three areas of accident analyses are impacted by the solids in Tank 50H: (1) Waste Tank and Waste Tank Annulus Explosions; (2) Transfer Line and Transfer Facility Explosions; and (3) Tank 50H Criticality. Each of these is discussed below.

5.4.1 Waste Tank and Waste Tank Annulus Explosions

When the majority of the liquid was removed from Tank 50H and transferred to Saltstone in 2002, about 61,000 gallons of solids were discovered to be located in two mounds in the bottom of the tank outside of the effective cleaning radius of the original two slurry pumps. These solids were found to contain organic material with TPB solids that could release benzene when significant quantities of solids are disturbed. The CSTF DSA assumes a 5% maximum contribution to vapor space LFL from organics. However, due to the TPB solids in the tank and the potential for chemical degradation of TPB creating benzene in amounts larger than allowed in the DSA, protecting 7 days to LFL cannot be determined with certainty. Thus, the Discovery USQ declared (Reference 2) is still applicable under the new CSTF DSA and a JCO is necessary until such time as sufficient solids have been removed that the CSTF DSA assumption regarding organic impacts to the LFL is satisfied.

The CSTF DSA, section 3.4.2.11, concludes that an explosion in a waste tank must be prevented. This conclusion was based on the potential consequences exceeding the offsite and onsite Evaluation Guidelines using bounding waste (sludge-slurry representing 1.5E+9 rem/gal inhalation

dose potential). The waste within Tank 50H is well below this bounding waste. Reference 9 was prepared to show the consequences from a Tank 50H explosion using the same methodology employed in DSA section 3.4.2.11, which DOE approved in Reference 1. The consequences in Reference 9 used waste with an inhalation dose potential of 1E+4 rem/gal, which bounds the waste in Tank 50H. The resulting offsite radiological consequences of a Tank 50H explosion would be about 2 mrem and the onsite (100 meter) consequences would be about 1 rem. These values are well below the Evaluation Guidelines (EG) in DOE-STD-3009 of 25 rem offsite and the current WSRC Manual E7, Procedure 2.25, EG of 100 rem onsite. These consequences take into account the potential contribution from charring of TPB solids, based on studies showing that Tank 48H solids, which contained significantly higher organic to non-organic ratio and curie content than the Tank 50H solids, would contribute less than 2% to the deflagration consequences.

Because the consequences for an explosion in Tank 50H are well below the EGs for an Anticipated event, no prevention or mitigation is required other than protecting assumptions for consequence determination (e.g., inhalation dose potential of material in the tank). The JCO requires the material in Tank 50H to be maintained less than 1E+4 rem/gal and prohibits transfers of any material to Tank 50H with an inhalation dose potential of greater than 1E+4 rem/gal. However, since an explosion within Tank 50H is considered unacceptable, regardless of radiological consequences, all the controls specified in the CSTF DSA and TSRs to prevent an explosion will be maintained, with the following exceptions/clarifications:

1. Tank 50H will be designated a "Rapid Generation Tank," regardless of the calculated time to reach LFL
   [*results in more stringent ventilation and LFL monitoring controls than a Slow or Very Slow Generation Tank*]
2. Tank 50H LFL monitor will have its output response adjusted for benzene
   [*DSA/TSR requires calibration/output response for hydrogen only. Since benzene may dominate the vapor space rather than hydrogen, the adjustment for benzene is prudent. Additionally, calibrating for benzene provides a conservative response to hydrogen.*]
3. Tank 50H will not be required to enter the "Gas Release Mode" defined in the DSA/TSRs during slurry pump operation, even though, depending on the assumptions used regarding benzene retention and release, the vapor space could be shown to exceed 25% LFL due to pump operation
   [*this exclusion is necessary since Tank 50H does not have the installed equipment to meet the prerequisites to enter the Gas Release Mode. This exclusion is sufficient given*
   a. *the low consequences from a potential explosion*
   b. *the fact that the estimated benzene release rate, which was the basis for the conclusion that the 7 days to LFL may not be protected, was based on conservative extrapolation of data from testing of Tank 48H material. Tank 48H material has a significantly higher copper concentration and TPB solubility than the Tank 50H material (Reference 10) and both of these factors add to the benzene release rate.*
   c. *during the addition of waste from Tank 49H to Tank 50H in 2001 and the subsequent slurrying of that waste, elevated benzene or LFL levels were not detected in Tank 50H. Since that evolution concluded, routine benzene sampling in the Tank 50H vapor space has indicated less than 2 ppm.*
   d. *several hundred gallons of the north mound were moved by water lancing earlier in 2003, again with no elevated benzene or LFL levels detected.*

e. *the TSR LCOs require slurry pump operation to be secured (albeit allowed to be by an operator versus interlocks) if ventilation is lost or if the LFL monitor exceeds 15% LFL (accounts for instrument uncertainty to protect DSA limit of 25% LFL).*

Thus, there is full expectation that solids agitation due to slurry pump operation will not cause the Tank 50H vapor space to exceed 25% LFL.]

4. Tank 50H LFL monitor instrument uncertainty does not have to meet the 10% value in the CSTF TSR LCO (3.8.2).

   [*The existing Tank 50H LFL monitor, calibrated for benzene, has an instrument uncertainty of 12.22% LFL. Thus, when the monitor reads at the TSR LCO limit of 15% LFL, the actual vapor space may actually be at 27.22% LFL versus the DSA requirement of 25% LFL. This potential 2.22% LFL difference is considered insignificant during this JCO.*]

5. Tank 50H does not have to meet the requirement to have 7 days to reach 100% LFL upon loss of ventilation during pump operation or upon an earthquake.

   [*since there is uncertainty in how much and how fast benzene could be released due to agitation of the solids from slurry pump operation or an earthquake, it cannot be assured that at least 7 days exist before reaching 100% LFL. However, as discussed under exception item 3 above, this is not expected and is justified.*]

5.4.2 Transfer Line and Transfer Facility Explosions

Transferring Tank 50H material to Saltstone poses the potential to leak and/or accumulate waste in various locations along the path (e.g., the transfer line, transfer line jacket, Tank 50H valve box, leak detection box drain cell, etc.). Under bounding waste assumptions, some of these accidents must be prevented. With the potential organic levels in the Tank 50H material, the current DSA/TSR controls are not fully adequate. Given the restriction in Tank 50H material to be < 1E+4 rem/gal, the consequences of these accidents would be well below the offsite and onsite EGs. However, to ensure the potential accumulation of the higher organic material in Tank 50H is confined, the JCO requires that the Tank 50H material can only be transferred to Saltstone and that the transfer path be isolated from any other CSTF location at valve WTS-V-274 within the Tank 50H valve box. This isolation point ensures no other CSTF location can receive the higher than allowed organic material. DOE reviewed drawings M-M6-H-9815 (Rev. 4), M-M6-H-8223 (Rev. 9), M-M6-H-8301 (Rev. 4), and M-M6-H-8300 (Rev. 11) and confirmed isolation at valve WTS-V-274 was appropriate and adequate to prevent inadvertent introduction of organics into any other CSTF location.

5.4.3 Evaluation of Tank 50H Solids Criticality Analysis

Analysis of the solids currently in Tank 50H found they have enrichments from 0.27 to 0.40 wt.% (References 11 and 12), which is well below the ANSI/ANS 8.1 single parameter enrichment limits applicable to uranium mixed homogeneously with water (0.93 wt.% for metal and 0.96 wt.% for oxides). The ANSI/ANS standard indicates that homogeneous mixtures had particle sizes of about 60 micrometers, whereas Tank 50H solids sample results indicate the particle sizes were less than 30 micrometers. The mounds were formed by the routine agitation of slurry pumps in Tank 50H. Based on the relatively large amount of water in the solids, the small particle size, and the low uranium content, the solids can be considered homogeneous (Reference 13). Therefore, ANSI/ANS 8.1 can be applied to the Tank 50H solids. The solids also contain a large amount of sodium and other neutron absorbers. Given the low uranium content, the low enrichment, and the large amount of neutron poisons, the Tank 50H solids will remain subcritical (Reference 14).

The JCO requires that additional waste added to Tank 50H not exceed a uranium enrichment of 0.93 wt.% so the contents of Tank 50H will remain subcritical. Thus, this JCO control is appropriate and adequate to protect Tank 50H from criticality concerns.

Based on DOE review and evaluation above, DOE concluded the analyses and controls in JCO WSRC-TR-2003-00083, Revision 0, are adequate to prevent and mitigate potential hazards due to the existence, agitation, and transfer of the Tank 50H solids material.

5.5 HDB-1 Inactive Status

The DSA and TSRs approved by DOE in Reference 1 described HDB-1 as an area allowed to conduct waste processing activities. As such, the conductivity probe was required to be set at a level to detect waste leakage into the bottom of HDB-1 during transfers associated with HDB-1. Additionally, periodic checks were required to ensure significant waste did not accumulate in HDB-1, even if transfers associated with HDB-1 were not conducted. Difficulties arose in placing the conductivity probe at the required level (debris, mud, etc. prevented proper placement). Instead of cleaning out HDB-1, since no future plans call for the use of HDB-1, the DSA and TSRs have been revised to add HDB-1 to the list of areas which are prohibited from any waste processing activities. This is the same approach taken in the DSA and TSRs approved by DOE in Reference 1 for FDB-1, HPP-1, etc. Since this prohibition will ensure the same function as the conductivity probe and periodic checks, DOE finds this change acceptable.

DOE review of the proposed changes found all the DSA sections modified (e.g., Chapters 2, 3, 4, and 5) to be internally consistent and compliant with the criteria in DOE-STD-3009, and found the TSR revisions to be internally consistent, consistent with the derivation in the DSA, and compliant with the criteria in DOE Guide G 423.1-1.

5.6 *Tank 41H NCSE*

A statement was added to the DSA Chapter 6 stating that salt removal activities on Tank 41H (interstitial removal and salt dissolution) were shown to be safe from a criticality perspective. The referenced NCSE (N-NCS-H-00151, Rev. 1) was reviewed and found to adequately address the various aspects of Tank 41H salt removal and to conclude that criticality is not possible.

An additional review of the NCSE was performed by a DOE criticality safety subject matter expert from the Nuclear Material Engineering Division (NMED). This review found that the NCSE: meets the general format requirements of DOE-STD-3007-93 and DOE-STD-1134-99; provides adequate documentation in accordance with the Double Contingency Analysis Methodology identified in WSMS-CRT-00-0024 and WSMS-CRT-01-0116; and the scenarios identified are adequately dispositioned as incredible. Based on the review of the NCSE, a criticality event in Tank 41H is considered incredible. A review of the proposed changes to the SB documents described above finds them to be appropriate.

5.7 Miscellaneous clarifications and editorial corrections

Several technical clarifications were made in the changes submitted in References 4 and 5:

1. Revised DSA section 3.4.2.6 and associated sections in Chapter 5 and TSR to clarify that post-sludge slurry flushing was needed to meet the bounding supernate inhalation dose potential (9.8E+7 rem/gal) versus the 1 wt% solids. This requirement was to reduce the waste material in a sludge slurry transfer to an inhalation dose potential equivalent to the bounding supernate

material. If the sludge slurry transfer material (even at a solids content greater than 1 wt%) was already less than 9.8E+7 rem/gal, no flushing would be needed.

2. Revised DSA section 3.4.1.5.3 to clarify that excluding the top 40" of sludge (in tanks under a Quiescent Time program) in the determination of the amount of trapped gas was also applicable to pump-induced gas release calculations (previously implied only applicable for seismic-induced releases).
3. TSR LCO 3.7.2 and 3.7.3 were revised to clarify the reference point for diversion box conductivity probe setting (sump floor or cell floor).
4. TSR LCOs 3.8.1, 3.8.2, 3.8.5, 3.8.9, and 3.8.10 were revised to add/correct several component identifiers and to reflect required setpoints on waste tank ventilation flow indicators and hydrogen monitors based on uncertainty calculations.

Additionally, several editorial changes were made. For example, DSA Table 4.3-2 was revised to reflect that the alarm for the waste tank low ventilation flow was not credited to be seismically qualified, consistent the associated text in section 4.3.13.1. Chapter 15 was revised to reflect that the F and H Areas Emergency Plan Administrative Manuals were combined into a single manual. Table 3.8.2-2 in TSR LCO 3.8.2 was modified to include a clarifying note similar to that in Table 3.8.2-1.

DOE review of the proposed changes found all the DSA sections modified (e.g., Chapters 2, 3, 4, 5, and 15) to be internally consistent and compliant with the criteria in DOE-STD-3009, and found the TSR revisions to be internally consistent, consistent with the derivation in the DSA, and compliant with the criteria in DOE Guide G 423.1-1.

6.0 Conditions of Approval

None

7.0 Conclusions

Based on the evaluation documented in Section 5 of this SER supplement, DOE review of the SB changes concludes the hazards associated with the Design Basis Accidents have been identified and the appropriate SB controls applied to protect the onsite workers, the general public, and the environment. Therefore, the proposed changes submitted in References 4 and 5 are approved. DOE did identify one Revision Issue (CSTF-0-1-R1), discussed in section 5.3, which is required to be addressed no later than the next annual update of the DSA.

8.0 References

1. Letter, Allison to Pedde, DOE CSTF SER Revision 0 for CSTF DSA/TSR, PC-03-008, 12/20/02.
2. Evaluation of Solids in Tank 50, USQ-WPT-2003-00035, 2/5/03.
3. Letter, Allison to Pedde, DOE ITPF SER Revision 4, Supplement 7, for ITPF SAR Addendum and OSRs, PC-03-015, 2/18/03.
4. Letter, Johnson to Anderson, "Submittal of Safety Basis Documents to DOE for Review and Approval," CBU-2003-00028, 2/20/03.
5. Letter, Johnson to Anderson, "Submittal of Safety Basis Documents to DOE for Review and Approval," CBU-2003-00034, 3/4/03.
6. Memorandum, Cope to Schwenker, "Assessment of Post-Seismic Risk to the Onsite Evaluation Point for CSTF," WSMS-LIC-03-0150, 3/4/03.
7. Letter, Fiori to Schwallie, DOE ITPF SER Revision 2 for ITPF SAR Addendum and OSRs, MC-95-0052, 8/4/95.
8. Letter, Anderson to Piccolo, DOE ITPF SER Revision 4 for ITPF SAR Addendum and OSRs, PC-01-034, 5/23/01.
9. Evaluation of Tank 50 Airborne Release Accidents, WSMS-LIC-03-00148, 1/23/03.
10. KTPB Decomposition Rate During Slurrying of Solids in Tank 50H, SRT-LWP-2003-00019, 2/4/03.
11. Results of Sample Analysis from Solids Removed from Tank 50H, WSRC-TR-2002-00506, 10/31/02.
12. Results of Sample Analysis of Tank 50H South Mound Solids, WSRC-TR-2003-00068, 1/20/03.
13. Uniformity of Solids in Tank 50, WSMS-CRT-03-0019, 2/13/03.
14. Criticality Safety of Solids in Tank 50, WSMS-CRT-02-0089, 11/1/02.

MAR 25 2003

Mr. Robert A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 2, Tank 41 Initial Interstitial Liquid Removal Safety Basis Revision

Reference: Letter, Johnson to Allison, "Submittal of Tank 41 Initial Interstitial Liquid Removal, Safety Bases Revision to DOE for Review and Approval)," CBU-2003-00037, 3/12/03

The Department of Energy (DOE), Savannah River Operations Office (SR) has evaluated the safety basis document changes submitted in the referenced letter. DOE-SR approves these safety basis document changes. The enclosed SER Revision 0, Supplement 2 documents the basis for approval.

You are requested to take action to add the safety basis document changes (Documented Safety Analysis [DSA] Change Request HLW-CRF-03006 and Technical Safety Requirement [TSR] Revision 2003-a) into the safety basis defined in the High Level Waste Division Authorization Basis Manual (WSRC-IM-94-10) upon implementation of the changes. Upon completion of initial interstitial liquid removal and before commencing bulk salt dissolution in Tank 41H, you are requested to cancel DSA Change Request HLW-CRF-03006 and add TSR Revision 2003-b into the High Level Waste Division Authorization Basis Manual.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or your staff may contact Carroll McFall at 208-8249.

Sincerely,

Original signed by
C.A. Hansen
for Jeffrey M. Allison
Manager

ED:CNM:kl

PC-03-019

Enclosure:
CSTF SER, Rev. 0, Supplement 2

cc w/encl:
W. J. Johnson, WSRC, 703-H
D. B. Little, WSRC, 703-H

cc w/o encl:
H. T. Conner, Jr., WSRC, 703-A
L. J. Hollick, WSRC, 703-A
W. S. Elkins, WSRC, 730-B
W. T. Davis, WSRC, 707-H

bc w/encl:
T. C. Temple, ED
D. J. Blake, ED
J. A. Smartt, ERAD, 730-B
R. J. Hardwick (EH-2), HQ

bc w/o encl:
MGR Rdg File
AMHLW Rdg File
ED Rdg File
IMS
ECAT, 703A DMC #03098 Due:3/27/03

Enclosure, Letter, Allison to Pedde, "CSTF Safety Evaluation Report (SER) Revision 0, Supplement 2," Dated:

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 2

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 0,
Change Request Package HLW-CRF-03006, Rev. 0

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2003-a

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2003-b

March 2003

Prepared by : N. Carroll McFall
N. Carroll McFall

Reviewed by: Thomas C Temple
Thomas C. Temple

Approved by:
~~Michael A. Mikolanis, Director~~
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR HIGH LEVEL WASTE
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 2

Executive Summary

The current revision of the CSTF Documented Safety Analysis (DSA) and Technical Safety Requirements (TSRs) compliant with 10CFR830, Subpart B, were approved by DOE via SER Revision 0 and Supplement 1. These documents, which are scheduled to be implemented by the end of March 2003, require waste tanks in the Gas Release Mode (except Tanks 8F, 40H, 42H, and 51H) to have a Safety Class (SC) purge ventilation low flow interlock and alarm, a Safety Significant (SS) high lower flammability limit (LFL) interlock, and an LFL monitor low sample flow alarm. The interlocks perform several actions (stop slurry pumps, isolate incoming salt dissolution water, stop interstitial liquid removal transfer pumps) in the event of low purge ventilation flow or high LFL. During DSA development, salt removal was expected to be completed on Tank 41H prior to DSA implementation so that installation of the interlocks would not be required. However, the Tank 41H salt removal schedule has been delayed and interstitial liquid removal from Tank 41H has begun under the previous Safety Basis (SB) documents. In order to continue interstitial liquid removal on Tank 41H for a period of time after the 10CFR830, Subpart B, compliant DSA and TSRs are implemented, the changes evaluated in this SER supplement will revise the DSA and TSRs to exempt Tank 41H from the above mentioned interlocks and alarms. This exemption applies only to initial interstitial liquid removal and does not apply to subsequent bulk salt dissolution activities which will follow initial interstitial liquid removal. The following summarizes the changes:

1. The DSA will be revised (HLW-CRF-03006) in several places in Chapters 3, 4, and 5 and the TSR Limiting Conditions for Operation (LCOs) 3.8.8, 3.8.9, and 3.8.10 will be revised (Revision 2003-a) to exempt Tank 41H from the requirement to have a SC purge ventilation low flow interlock and alarm, a SS high flammable vapor interlock, and a SS LFL monitor low sample flow alarm during initial interstitial liquid removal when in the Gas Release Mode.
2. The DSA revision above will be canceled and the TSR Limiting Conditions for Operation (LCOs) 3.8.8, 3.8.9, and 3.8.10 will be revised (Revision 2003-b), after completion of initial interstitial liquid removal and before bulk salt dissolution begins, to reinstate purge ventilation and flammable vapor interlocks for Tank 41H while in the Gas Release Mode.

The specific safety basis documents submitted for review and approval are:

1. Change Request Package HLW-CRF-03006, Rev. 0 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
2. CSTF TSRs, S-TSR-G-00001, Revision 2003-a
3. CSTF TSRs, S-TSR-G-00001, Revision 2003-b

Based on the evaluation documented in this SER supplement, DOE review of the safety basis changes above concludes the hazards associated with the Design Basis Accidents have been identified and the appropriate safety basis controls applied to protect the onsite workers, the general public, and the environment. No Conditions of Approval are identified within this SER supplement. Therefore, the proposed changes submitted are approved.

1.0 Introduction

The current revisions of the CSTF DSA and TSRs compliant with 10CFR830, Subpart B, were approved by DOE via SER Revision 0 and Supplement 1. These documents, which are scheduled to be implemented by the end of March 2003, require waste tanks in the Gas Release Mode to have a SC ventilation low flow interlock and alarm, a SS high LFL interlock, and a SS LFL monitor low sample flow alarm. During DSA development, salt removal was expected to be completed on Tank 41H prior to DSA implementation so that installation of the interlocks would not be required. However, the Tank 41H salt removal schedule has been delayed and interstitial liquid removal from Tank 41H has begun under the previous Safety Basis (SB) documents, which do not require the ventilation and LFL interlocks. Installation of the interlocks at this time would take at least a month, which would either unnecessarily delay salt removal from Tank 41H with no appreciable benefit as explained in Section 5 below or delay implementation of the 10CFR830, Subpart B, compliant DSA and TSRs. In order to continue interstitial liquid removal on Tank 41H for a period of time after the 10CFR830, Subpart B, compliant DSA and TSRs are implemented, the changes evaluated in this SER supplement will revise the DSA and TSRs to exempt Tank 41H from the above mentioned interlocks and alarms. This exemption does not apply to bulk salt dissolution activities which will follow initial interstitial liquid removal. The following summarizes the changes:

1. The DSA will be revised (HLW-CRF-03006) in several places in Chapters 3, 4, and 5 and the TSR Limiting Conditions for Operation (LCOs) 3.8.8, 3.8.9, and 3.8.10 will be revised (Revision 2003-a) to exempt Tank 41H from the requirement to have a SC purge ventilation interlock and alarm, a SS flammable vapor interlock, and a SS LFL monitor low sample flow alarm during initial interstitial liquid removal when in the Gas Release Mode.
2. The DSA revision above will be canceled and the TSR Limiting Conditions for Operation (LCOs) 3.8.8, 3.8.9, and 3.8.10 will be revised (Revision 2003-b), after completion of initial interstitial liquid removal and before bulk salt dissolution begins, to reinstate purge ventilation and flammable vapor interlocks for Tank 41H while in the Gas Release Mode.

The specific safety basis documents submitted for review and approval are:

1. Change Request Package HLW-CRF-03006, Rev. 0 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
2. CSTF TSRs, S-TSR-G-00001, Revision 2003-a
3. CSTF TSRs, S-TSR-G-00001, Revision 2003-b

2.0 Background

The submitted changes to the safety basis in Reference 1 do not alter the purpose, mission, or Hazard Category of the CSTF. DOE CSTF SER Revision 0 (Reference 2) remains applicable for these topics. This SER provides an exemption from additional controls (interlocks) for a limited period of time (initial interstitial liquid removal) on Tank 41H. Based on a drain analysis (Reference 3), this is expected to be about 60 days (although this SER supplement does not limit the duration).

3.0 Review Process

WSRC submitted these safety basis changes to support Tank 41H interstitial liquid removal in Reference 1.

This SER supplement (Supplement 2) is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

4.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, and the various DSA sections were consistent. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 (Reference 3) were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs: (1) are clear with respect to process area applicability; (2) provide adequate justification to support Limiting Conditions for Operation (LCO) conditions, actions and surveillance requirements; (3) provide clear administrative controls; and (4) are consistent with the accident descriptions and credited controls.

5.0 Evaluation

The changes identified in Section 1.0 above were evaluated using the criteria established in Section 4.0 above. The DSA was revised in several places in Chapters 3, 4, and 5 (HLW-CRF-03006) to exempt Tank 41H from the purge ventilation low flow interlock and alarm requirements and from the high LFL interlock and low LFL monitor sample flow alarm requirements when the tank is in the Gas Release Mode during interstitial liquid removal. The changes also state that the interlocks and alarm requirements will still be applicable during bulk salt dissolution and that interstitial liquid removal may not transition into bulk salt dissolution without the interlock and alarm requirements being met. The TSR Limiting Conditions for Operation (LCOs) 3.8.8, 3.8.9, and 3.8.10 were also revised (Revision 2003-a) to exempt Tank 41H from

a. the purge ventilation low flow interlock and alarm requirements,
b. the high LFL interlock, and
c. low LFL monitor sample flow alarm requirements

during interstitial liquid removal. These interlocks and alarms will still be applicable during subsequent bulk salt dissolution. The interlocks that have been exempted were identified to automatically stop the pumping of liquid from waste tanks during interstitial liquid removal in the Gas Release Mode to prevent flammable vapor (i.e., hydrogen) building up in the tank vapor space in the case of low purge ventilation flow or high LFL conditions. The Gas Release Mode applies to waste tanks with a potential to rapidly release hydrogen and exceed 25% LFL (Reference 4). Based on a drain analysis, the initial interstitial liquid removal is expected to last about 60 days although this SER supplement does not limit the duration. As stated in the letter accompanying the proposed changes (Reference 1), once the initial interstitial liquid removal activity is complete, the DSA

change (HLW-CRF-03006) will be cancelled and TSR change (Revision 2003-b) will be implemented to eliminate the exemption for Tank 41H for subsequent salt removal activities including bulk salt dissolution and subsequent interstitial liquid removal evolutions.

The TSR LCOs 3.8.8, 3.8.9, and 3.8.10 were also revised to:

a. clarify in the LCOs and associated Bases that Tanks 40H, 42H, and 51H do not process saltcake and that Tank 41H does not process sludge,
b. add a reference for an updated uncertainty calculation for Tank 41H, and
c. add statements that the low purge ventilation flow and high hydrogen concentration interlocks shall stop the transfer pump/jet on tanks undergoing interstitial liquid removal.

Free supernate and interstitial liquid removal in Tank 41H began on September 8, 2002 utilizing the previous (non-10CFR830 compliant) SB documents and have continued intermittently since then. The previous SB controls under which interstitial liquid is currently being removed are similar to those proposed for Tank 41H in Reference 1 (i.e., an operator will stop pumps for low purge ventilation flow, a high LFL alarm, or low sample flow to the LFL monitor).

The supernate level in Tank 41H was 357 inches and the salt level was 350 inches when supernate and interstitial liquid removal began last year. At the present time, free supernate removal has been completed and interstitial liquid removal has progressed so that the liquid level in Tank 41H has been reduced from 357 inches to 171 inches. Salt studies at Hanford (Reference 5) concluded that the slower liquid is removed from a salt tank, the slower hydrogen is released into the vapor space. These studies also concluded that trapped gas bubbles are released from salt cake by expansion due to decrease in hydrostatic pressure and diffusion through exposed channels as liquid is removed. Releasing trapped gas from saltcake is accompanied by an increase in the vapor space of the tank as liquid is removed from the exposed channels. This will decrease the hydrogen concentration in the vapor space.

The amount of hydrogen trapped within the saltcake in Tank 41H (which has sat idle for years) is not directly related to the hydrogen generation rate, but is related to the holding power of the salt cake. Hanford has measured 6-16% void space within its salt cake, with the average for the bulk saltcake being 11%. Measurements and back calculations from Tank 36H and past salt removal in Tank 41H have concluded ~11% void space as well. The DSA cites 11% is to be used for the salt cake calculations, which DOE reviewed and approved in SER Rev 0. Assuming the trapped hydrogen is evenly distributed throughout the saltcake, approximately 50% of the trapped hydrogen has been released based on an initial salt level of 350 inches and the current liquid level of 171 inches. If the 171 inches of remaining interstitial liquid was instantaneously removed and the associated hydrogen dispersed in all the vapor space (salt void vapor space plus vapor space above 350 inches (salt cake level)), the resulting concentration of hydrogen in the vapor space would be about 23% LFL (Reference 6) given an 11% void space.

Since Tank 41H will not have the automatic interlocks installed for initial interstitial liquid removal, DOE used Reference 6 and varied several inputs to determine the effects on flammable gas concentrations. Assuming the worst case void space measured in the Hanford tests of 16% and the trapped hydrogen evenly distributed throughout the saltcake, the resulting concentration of hydrogen in the vapor space would be about 31% LFL.

If it is assumed that none of the hydrogen trapped in the saltcake in Tank 41H has been released by draining the interstitial liquid from 350 inches down to 171 inches, instantaneously removing the remaining 171 inches of interstitial liquid given an 11% void space would result in a concentration of hydrogen in the vapor space of 37% LFL. [Note that, if draining from 350 inches to 171 inches did not release trapped hydrogen, it is likely that draining below 171 inches will not either since the trapped hydrogen below 171 inches would have to percolate up through the same salt matrix before being released.] Once again, assuming the worst case void space measured in the Hanford tests of 16%, the resulting concentration of hydrogen in the vapor space would be 50% LFL. Given that the heat load in Tank 41 is very low (and will be much lower when the interstitial liquid is removed), once the vapor space reached the maximum level of 50% LFL, the continual increase in % LFL would be very slow due to the small remaining radiolytic generation rate of hydrogen.

The assumption of instantaneously removing all 171 inches of interstitial liquid is very conservative. A maximum drain rate less than 10 gallons per minute (gpm) is possible for the remaining interstitial liquid removal and the drain analysis (Reference 3) estimates that it will take about 60 days to remove the remaining interstitial liquid. Actual experience during free supernate and interstitial liquid removal in Tank 41H last year found the concentration of hydrogen in the vapor space of the tank ranged between 1% LFL and less than 3% LFL. Given the very slow maximum drain rate and the experience during free supernate removal last year, the actual hydrogen vapor space concentration in the tank is not expected to rise significantly above the normal background level. Additionally, if a hydrogen release occurs more quickly than expected and exceeds the LCO value of 15% LFL (protects 25% LFL accounting for instrument loop uncertainty), the LCO requires immediate termination of pump operation. Thus, Tank 41H does not represent a flammable gas concern, even under very conservative assumptions.

These changes to the DSA and TSRs do not increase the risk or consequences of an accident in tank 41H above that which is currently accepted because the controls that will be implemented by this change are similar to those being used currently to drain interstitial liquid under the previous SB documents. With the maximum drain rate of less than 10 gpm that is afforded by the pump, the hydrogen concentration in the Tank 41H vapor space is expected to remain very low.

DOE review of the proposed changes to the DSA and TSRs found them to be consistent with the supporting analyses, found all the DSA sections modified (i.e., Chapters 3, 4, and 5) to be internally consistent and compliant with the criteria in DOE-STD-3009, and found the TSR revisions to be internally consistent, consistent with the derivation in the DSA, and compliant with the criteria in DOE Guide G 423.1-1.

TSR Revision 2003-b will be implemented following initial interstitial liquid removal in Tank 41H and before bulk salt dissolution. It will reinstate the engineered controls in the TSRs (i.e., interlocks and alarms) to their state prior to Revision 2003-a except it will retain the following clarifications in the LCOs and Bases:

a. Tanks 40H, 42H, and 51H do not process saltcake and that Tank 41H does not process sludge,
b. add a reference for an updated uncertainty calculation for Tank 41H, and
c. add statements that the low purge ventilation flow and high hydrogen concentration interlocks shall stop the transfer pump/jet on tanks undergoing interstitial liquid removal.

Because this change (Revision 2003-b) will re-institute the safety controls for Tank 41H, it is acceptable.

6.0 Conditions of Approval

None.

7.0 Conclusions

Based on the evaluation documented in Section 5 of this SER supplement, DOE review of the SB changes concludes the hazards associated with the Design Basis Accidents have been identified and the appropriate SB controls applied to protect the onsite workers, the general public, and the environment. Therefore, the proposed changes submitted in Reference 1 are approved.

8.0 References

1. Letter, Johnson to Anderson, "Submittal of Tank 41 Initial Interstitial Liquid Removal Safety Bases Revision to DOE for Review and Approval (U)," CBU-2003-00037, 3/12/03.
2. Letter, Allison to Pedde, DOE CSTF SER Revision 0 for CSTF DSA/TSR, PC-03-008, 12/20/02.
3. Tank 41 Low Curie Salt Drain Analysis and Expected Feed, CBU-SPT-2003-00035, 2/21/03.
4. CSTF TSRs, S-TSR-G-00001, Rev. 0.
5. Gas Release During Salt-Well Pumping: Model Predictions and Laboratory Validation Studies for Soluble and Insoluble Gases, PNNL-11621 UC-2030, August 1997.
6. Justification for Tank 41 Low Curie Salt Interstitial Liquid Removal with DSA Gas Release Interlocks, CBU-SPT-2003-00049, Rev. 1, 3/11/03.

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

MAY 0 9 2003

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 3, Tank 19F - Removed From Service Mode - Request Approval to Place Tank 19 in "Removed From Service" Mode (Letter, Johnson to Anderson, 4/04/03)

The Department of Energy (DOE) Savannah River Operations Office (SR) has evaluated the safety basis document changes submitted in the letter dated April 4, 2003, from Michael Johnson to Charles Anderson, subject: Request Approval to Place Tank 19 in "Removed From Service" Mode. DOE-SR approves these safety basis document changes. The enclosed SER Revision 0, Supplement 3 documents the basis for approval.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or your staff may contact Roberto Gonzalez at 208-8175.

Sincerely,

Jeffrey M. Allison
Manager

PC-03-025

Enclosure:
CSTF SER
Revision 0, Supplement 3

cc w/encl:
W. J. Johnson, WSRC, 703-H
D. B. Little, WSRC, 703-H

cc w/o encl:
H. T. Conner, Jr., WSRC, 730-1B
L. J. Hollick, WSRC, 703-A
B. S. Elkins, WSRC, 730-B
W. T. Davis, WSRC, 707-H

Enclosure, Letter, Allison to Pedde, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 3, Tank 19F – Removed From Service Mode – Request Approval to Place Tank 19 in 'Removed From Service' Mode," Dated:

MAY 0 9 2003

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 3

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF) OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

TANK 19F – REMOVED FROM SERVICE MODE

April 2003

Prepared by: _____
Roberto Gonzalez

Reviewed by: _____
Donald J. Blake

Approved by: _____
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR HIGH LEVEL WASTE
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 3

Executive Summary

WSRC has requested approval to place Tank 19F in "Removed From Service" (RFS) mode. DOE has reviewed submitted documentation and has determined that Tank 19F meets RFS mode safety requirements as stated Technical Safety Requirements (TSR) Section 1.6.1.

This CSTF Safety Evaluation Report supplement provides DOE assessment of Tank 19F conditions and validates that Tank 19F meets RFS mode conditions as defined on section 1.6.1 of the CSTF TSRs.

The result of this action is that controls directly applicable to waste tanks and associated equipment are not required for Tank 19F. Therefore, administrative control programs such as Corrosion Controls, Structural Integrity, Sludge Carryover Minimization, Transfers from Waste Tank Annuli, Flammable Vapor Sampling Monitoring, Pump Run, etc. are no longer applicable to Tank 19F. Likewise, equipment and associated TSR Limiting Conditions for Operation (LCOs) for Tank Ventilation, Tank Lower Flammability Limit (LFL) monitoring, High Liquid Level Conductivity Probe, etc. are no longer applicable to Tank 19F. However, the Sitewide safety programs such as Radiological Protection, Emergency Response, Quality Assurance, Industrial Hygiene, etc. discussed in DSA section 3.3.3.3.2 are still applicable for activities associated with Tank 19F.

1.0 Introduction

WSRC has requested DOE approval to place Tank 19F in the RFS mode (Reference 1). This SER supplement evaluates Tank 19F existing conditions and documents facility safety impacts as a result of placing Tank 19F in the RFS mode. Tank 19F heel removal is complete, and the tank is ready for closure.

The intent of the RFS Mode is to recognize that once a waste tank has had its waste removed to the point where it is ready for permanent closure (e.g., grouting), specific safety basis controls are no longer required to be applied since the hazard has been removed to the maximum extent possible (typically this results in a remaining heel of < 10's of thousands of gallons). The definition of the Removed From Service Mode requires DOE approval prior to entering into this Mode. Thus, DOE approval (via this SER supplement) will ensure that the tank meets both the 1E+12 rem limit and is ready for permanent tank closure (e.g., grouting) prior to entering the RFS Mode.

The basis for satisfying the RFS Mode conditions discussed below is to ensure that the hazards postulated to occur associated with waste tanks have been eliminated or the consequences have been reduced to well below the applicable Evaluation Guidelines (EGs).

2.0 Background

Tank 19F is a 1.3 million gallon capacity Type IV waste tank that was placed in service 1961. The tank is an 85' diameter flat-bottomed cylindrical carbon steel tank with a domed roof. The walls are roughly 35' high with the center height about 45'. In the early 80's, over one million gallons of radioactive waste salt were removed from Tank 19F using mechanical agitation. The resulting salt

solution was sent to Tank 18F. The remaining 33,000 gallons of waste was reduced by the Heel removal operations that commenced in September 2000 and ended in June of 2001. The waste heel was reduced from approximately 33,000 gallons to 15,000 gallons. Tank 19F heel removal is complete and the tank is ready for closure (References 2 and 3).

3.0 Evaluation

DOE reviewed the WSRC request (Reference 1) and supporting documentation to place Tank 19F into the RFS Mode. This DOE review concluded that Tank 19F meets the DSA/TSR requirements to be placed in the RFS mode. The following are Tank 19F conditions and justifications for entering the RFS mode:

	Criteria	Tank 19F Condition	Basis & Documentation
1.	Total effective inhalation dose potential ≤ 1.0E+12 rem	Inhalation Dose Potential 1.43E+10 rem based on sample results from Tank 19F	U-CLC-F-00002 – Tank 19 Inhalation Dose Potential
2.	Classified as Very Slow Tank	Tank meets definition of a Very Slow Tank	X-CLC-F-00401, Tank 19 Removed From Service Flammability Evaluation. N-ESR-G-00001, Rev 222, HLW Emergency Response Data and Waste Tank Data
3.	Tank vapor space less than 100% LFL post-earthquake	Tank meets criteria	X-CLC-F-00401, Tank 19 Removed From Service Flammability Evaluation, X-CLC-H-00113, rev.1, Tank 18 and 19 Reduced Surveillance
4.	Transfer line segments placed out of service	Transfer line has been designated out service	M-ML-G-0005, Structural Integrity Database (F/H Areas)
5.	Bearing water supply to pumps and cooling water supply/return blanked	N/A – meets criteria	No slurry pumps or cooling coils installed
6.	Air and steam supply blanked	Air and steam piping to the Tank 19F transfer jet has been removed and blanked. Power or energy source was removed making impossible to operate	M-M6-F-3363 (F Area Old hill Tank 19, Piping and instrumentation Drawings); FTF-TMC-99-016
7.	Waste transfers into and out of tank are prohibited	Power or energy source was removed to prime movers into and out of tank, making impossible to operate	FTF-TMC-99-016

8.	Operation of slurry pumps/mixers is prohibited and air supply to the pumps/mixers are isolated	Power or energy source was removed to installed mixers, making impossible to operate. Also, no air supply to slurry pump/mixers was installed.	FTF-TMC-99-016
9.	Liquid additions are limited to those listed in RFS Mode definition	Controlled by Administrative Controls	DSA WSRC-SA-2002-00007 and TSR S-TSR-G-00001 define allowable liquid additions. Liquid additions performed by procedures. USQD program ensures procedures consistent with DSA and TSRs

Additional Explanation and Comments for Criteria in above Table:

2,3. X-CLC-F-00401, Tank 19F Removed From Service Flammability Evaluation, concludes that Tank 19F has an equilibrium hydrogen concentration far less than 95% of LFL (calculation shows <2% LFL with the addition of 100,000 gallons of liquid to the current inventory). This meets the definition of a Very Slow Generation Tank. Additionally, the post-seismic vapor space concentration due to trapped gas release was shown to be far less than 100% LFL (calculation shows <6% LFL with the addition of 100,000 gallons of liquid to the current inventory). DOE reviewed calculation X-CLC-F-00401 and found it to:

a. be based on sample results from Tank 19F
b. be consistent with the Flammability Control Program methodology, WSRC-TR-2003-00087
c. properly adjust (dilute) the hydrogen scavenger concentration due to the potential for 100,000 gallons of water to enter the tank
d. be conservative by assuming the supernate temperature is at 100°C

Although the submittal demonstrates that Tank 19F does not reach flammable conditions, it neglected to consider the potential for flammable vapors in Tank 18 to migrate into Tank 19F through the open transfer piping. DOE review identified two cases where tank 18 might act as a source of flammable vapors to Tank 19F:

a. Steady-state H2 generation with Tank 18 ventilation system shutdown
b. H2 generation from Tank 18 sludge slurry/transfer operations

Steady-state case - In this case flammable vapor is only added to Tank 19F when a concentration gradient is present. Both Tank 18 and 19F are classified as very slow tanks (reference N-ESR-G-0001) and therefore, by definition, neither tank can reach 95% LFL under steady-state conditions. Thus, the presence of flammable vapor below LFL concentration within Tank 18 cannot result in a flammable condition in Tank 19F. This is supported through analyses, (reference X-CLC-F-00401

and WCS 1.5), that demonstrates that the maximum steady-state concentration of flammable vapor within tanks 19 and 18 are approximately 1.8% LFL and 1.0% LFL respectively.

Sludge slurry/transfer operations - Tank 18 ventilation is required in this case, which establishes a slight negative pressure within the tank. The lower pressure relative to Tank 19F results in an outflow of air from Tank 19F and prevents Tank 18 from becoming a source of flammable vapors during sludge slurry/transfer operations.

5,7. All waste transfer lines into or out of Tank 19F have been cut, sealed, or (as in the case of the Tank 19F to Tank 18 Transfer Line) the motive force for waste transfers has been removed. Electric wires and cables connected to Tank 19F and Tank 18 transfer line pumps were physically removed impeding reconnection.

No potential to siphon exists into or out of Tank 19 based on our current configuration for RFS Mode. There is no motive force that can be applied anywhere along the transfer line. All transfer equipment (Tank 19 Jet, Tank 19 Heel Removal Pumps, and Tank 18 Recycle Pump) has been isolated from its' power source. The transfer line from Tank 19 ends at the Tank 18 West Riser interior wall. It does not extend into Tank 18; therefore, it will not come into contact with Tank 18 waste contents. (Ref. M-M6-F-3363 and FTF-TMC-99-016, Rev. 26).

8. Temporary equipment installed to supply power to the mixers in Tank 19F has been removed.

9. Once Tank 19F is placed in Removed From Service Mode, then the DSA (WSRC-SA-2002-00007) and TSR (S-TSR-G-00001) limit the types of liquid additions. Any future proposed activity to add liquid to Tank 19F is required to be reviewed for compliance with the DSA and TSR via the USQD program.

The DOE SER supplement (Supplement 1) approving the development of the RFS Mode definition identified the issue of considering the effects of multiple tanks placed in the RFS Mode since the Seismic Event consequences reported in DSA Change Request HLW-CRF-03005, Rev. 1, only considered the failure of one tank in this Mode. Since no other tank is in the RFS Mode, then placing Tank 19F in this Mode does not jeopardize the reported consequences in DSA section 3.4.2.18.

Based on the evaluation documented in this SER supplement and DOE review of the documents in Section 6.0 below, DOE concludes that Tank 19F meets the "Remove from Service" Mode conditions. Therefore, the request to place Tank 19F in the "Remove from Service" Mode (Reference 1) is approved.

4.0 Conditions of Approval

No conditions of approval associated with this SER were identified as a result of this evaluation.

5.0 Conclusions

Based on the evaluation documented in Section 3.0 of this SER supplement, and DOE review of Tank 19F existing conditions, DOE concludes that Tank 19F meets all RFS mode requirements.

This SER supplement authorizes WSRC to proceed to place Tank 19F in The Removed from Service mode in accordance with DSA and TSR guidance.

6.0 References

The following documents were reviewed to determine that Tank 19F existing conditions are in compliance with "Removed from service" mode.

1. CBU-LWD-2003-00037, "Request Approval to Place Tank 19 in 'Removed From Service' Mode", April 4, 2003
2. WSRC-WRE-2002-00023, Rev. 2 "Technically and Economically Practical Endpoint Summary for Further Waste Removal Activities in Tank 19," February 4, 2003
3. CBU-2003-00022, "Request for Approval of CBU Waste Incidental to Reprocessing Evaluation for Tank 19 Closure and Concurrence on Tank 19 Closure Module," February 4, 2003
4. U-CLC-F-00002, "Tank 19 Inhalation Dose Potential," Rev. 0
5. X-CLC-F-00401, "Tank 19 Removed from Service Flammability Evaluation," Rev. 0
6. WSRC-TR-2002-00052, "Characterization of Tank 19 Residual Waste," Rev. 1
7. M-ML-G-0005, "Structural Integrity Database (F/H Areas)," Rev. 40
8. M-M6-F-3363, "F Area Old Hill Tanks 17,18, and 19 Waste Transfer System," Rev. 14
9. FTF-TMC-99-016, "Tank 19 Heel Removal Temporary Equipment," Rev. 26.
10. WSRC-TR-2000-00311, "Technology Evaluation Tank 19 Waste Removal Equipment," Rev. 1
11. S-TSR-G-00001, "Technical Safety Requirements - Concentration, Storage, and Transfer Facilities," Rev. 1, March 2003.
12. WSRC-SA-2002-00007, "Concentration, Storage, and Transfer Facilities Documented Safety Analysis", Rev. 0 December 2002, and Change Request HLW-CRF-03005, Rev.

MAY 2 7 2003

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 4 – Submittal of Tank 41 to Tank 50 Safety Basis Revisions to DOE for Review and Approval

References:
1. Letter, Johnson to Anderson, "Submittal of Tank 41 to Tank 50 Safety Basis Revision to DOE for Review and Approval," CBU-2003-00038, 5/7/03.
2. Letter, Johnson to Anderson, "Submittal of Revision 1 of the Concentration, Storage, and Transfer Facilities Justification for Continued Operation (JCO) to DOE for Review and Approval," CBU-2003-00045, 5/15/03.

The Department of Energy (DOE), Savannah River Operations Office (SR) has evaluated the safety basis document changes submitted in the referenced letters. DOE-SR approves these safety basis document changes. The enclosed SER Revision 0, Supplement 4, documents the basis for approval.

You are requested to take action to add the safety basis document changes (Documented Safety Analysis Change Requests HLW-CRF-03009 and HLW-CRF-3010; Technical Safety Requirement Revisions 2003-C and 2003-D; and JCO Revision 1) into the safety basis defined in the High Level Waste Division Authorization Basis Manual (WSRC-IM-94-10) upon implementation of the changes. There was one Condition of Approval identified in the enclosed SER supplement, that being to revise Reference 4 of the JCO to Revision 1. This page change is needed prior to implementing JCO Revision 1. DOE-SR has also identified one revision issue as discussed in Section 5.3.3 of the enclosed SER supplement. As stated in Reference 2, prior to initiating waste transfers from Tank 41H to Tank 50H, a revision to the CSTF Authorization Agreement is necessary. These actions have been discussed with David Little of your staff.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or your staff may contact Tom Temple at 208-8772.

Sincerely,

Original signed by
C.A. Hansen
for Jeffrey M. Allison
Manager

ED:TCT:eas

PA-03-0004

Enclosure:
CSTF SER
Revision 0, Supplement 4

cc w/encl:
W. J. Johnson, WSRC, 703-H
D. B. Little, WSRC, 703-H

cc w/o encl:
H. T. Conner, Jr., WSRC, 730-1B
L. J. Hollick, WSRC, 703-A
W. S. Elkins, WSRC, 730-B
V. G. Dickert, WSRC, 703-H
W. T. Davis, WSRC, 707-H

bc w/encl:
T. C. Temple, ED, 707-H
D. J. Blake, ED, 707-H
J. A. Smartt, EAD, 730-B
R. J. Hardwick, (EH-2), HQ

bc w/o encl:
MGR Rdg File
AMHLW Rdg File
ECAT, 703A, DMC # 030758 and #030822
ED Rdg File
IMS

"Concentration, Storage, and Transfer Facili
(CSTF) Safety Evaluation Report (SI
Revision 0, Supplement 4 – Submittal of T
41 to Tank 50 Safety Basis Revision to DOE
Review and Approval," Dated: MAY 2 7 200

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 4

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 0,
Change Request Package HLW-CRF-03009
Change Request Package HLW-CRF-03010

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2003-C
S-TSR-G-00001, Revision 2003-D

AND

CSTF JUSTIFICATION FOR CONTINUED OPERATIONS (JCO)

WSRC-TR-2003-00083, Revision 1

May 2003

Prepared by : TC Temple
Thomas C. Temple

Reviewed by: _____
Dave Faubert

Approved by: _____
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR HIGH LEVEL WASTE
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 4

Executive Summary

The CSTF Documented Safety Analysis (DSA) and Technical Safety Requirements (TSRs) compliant with 10CFR830, Subpart B, were approved by DOE via SER Revision 0 issued December 20, 2002. These approved DSA and TSRs did not evaluate simultaneous evaporator operation and separate waste transfers through the evaporator cells since the facility was not configured to accomplish this (i.e., piping, jumpers, and the proper motive force did not exist). Subsequently, the Contractor has initiated an effort to modify the CSTF to provide the capability to perform these simultaneous operations through the 242-16H Evaporator cell. This same operational flexibility may be needed in the future through the 242-16F Evaporator cell. Thus, DSA and TSR changes were developed to recognize and evaluate these simultaneous operations. Additionally, a clarification was made regarding equipment needed to stop waste tank additions and prevent a waste tank overflow. Influent manual isolation valves for non-batch transfers ($\geq$ 15,000 gallons or continuous make-up feed) are required to be functionally classified as safety significant.

The specific safety basis documents submitted for review and approval are:

- Change Request Packages HLW-CRF-03009 and HLW-CRF-03010 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
- CSTF TSRs, S-TSR-G-00001, Revisions 2003-C and 2003-D

Additionally, on March 14, 2003, DOE approved JCO WSRC-TR-2003-00083, Revision 0, which authorized removal of solids from Tank 50H using water or waste with an inhalation dose potential of $\leq$ 1.0E+04 rem/gal. Although solids have been removed, large volumes of inhibited water are involved in the dilution and transfer operations, which is causing large volumes of grout to be formed at the Saltstone facility. To continue the solids removal effort yet minimize the overall amount of grout stored in the Saltstone facility, while at the same time support the salt removal program in the Tank Farm, the Contractor has submitted a revision to the JCO to raise the inhalation dose potential to 2.8E+05 rem/gal and remove the enrichment control on incoming feeds to Tank 50H. This will allow the processing of the dissolved low curie salt material in Tank 41H to Tank 50H.

Based on the evaluation documented in this SER supplement, DOE review of the safety basis changes above concludes the hazards associated with the Design Basis Accidents have been identified and the appropriate safety basis controls applied to protect the onsite workers, the general public, and the environment. The following table summarizes the change in consequences, if any, due to the new allowance to operate the 242-16F and –16H Evaporators concurrent with making separate waste transfers through the same evaporator cell (note there are no changes in event frequency because of this new allowance).

Event	Existing Consequences (Rem) Onsite & Offsite	New Consequences (Rem) Onsite & Offsite	Comment
Evaporator Explosion	40 & <0.1	40 & <0.1	Explosion within 242-25H Evaporator bounds combined explosion/spill within 242-16F/16H Evaporator cell
Evaporator Cell Explosion	0.6 & <0.1	13.7 & <0.1	Onsite increase due to 242-16F/16H cell explosion combined with subsequent transfer jumper spill. Offsite dose had enough margin below 0.1 rem that the combined dose is still <0.1 rem
Evaporator Overflow, Leaks, and Spills	6.9 & <0.1	13.1 & <0.1	Onsite increase due to 242-16F/16H transfer jumper spill. Offsite dose had enough margin below 0.1 rem that the dose is still <0.1 rem
Seismic Event (Evaporator related consequence)	23.6 & <0.1	23.6 & <0.1	Over-pressure within 242-25H Evaporator bounded onsite events for 242-16F/16H. Offsite dose had enough margin below 0.1 rem that the combined dose is still <0.1 rem

The following table shows the change in consequences of the bounding event for Tank 50H due to the increase in allowable dose potential from 1.0E+04 rem/gal to 2.8E+05 rem/gal:

Event	Current Offsite Consequence (rem)	New Offsite Consequence (rem)	Current Onsite (100m) Consequence (rem)	New Onsite (100m) Consequence (rem)
Tank Explosion	0.0021	0.060	1	25

These new consequences are still well below the offsite Evaluation Guideline (25 rem) and onsite Evaluation Guideline (100 rem). Additionally, DOE review of the Nuclear Criticality Safety Evaluation prepared to remove the enrichment limit on incoming feeds to Tank 50H found it adequate and consistent with the requirements in DOE-STD-3007.

One Condition of Approval is identified in Section 6.0 of this SER supplement: Revise Reference 4 (N-NCS-H-00165) of the JCO to Revision 1. The Evaluation in Section 5.3 of this SER supplement discusses the need for this change. Therefore, the proposed changes submitted, with this Condition of Approval, are approved. DOE also identified one Revision Issue, as discussed in section 5.3.3.

1.0 Introduction

The CSTF Documented Safety Analysis (DSA) and Technical Safety Requirements (TSRs) compliant with 10CFR830, Subpart B, were approved by DOE via SER Revision 0 issued December 20, 2002 (Reference 1). The Safety Basis (SB) changes submitted via Reference 2 analyze and recognize the use of a transfer jumper within the 242-16H/16F evaporator cells for performing a waste transfer through the cell simultaneous to and unrelated to evaporator operation. The evaporator cell will be treated as a secondary containment and leak detection location for the waste transfer (similar to a Diversion Box).

The specific safety basis documents submitted for review and approval related to the new evaporator cell transfer jumper are:

- Change Request Package HLW-CRF-03009 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
- CSTF TSRs, S-TSR-G-00001, Revision 2003-C

In addition, a clarification was made regarding equipment needed to stop waste tank additions and prevent a waste tank overflow. Influent manual isolation valves for non-batch transfers ($\geq$ 15,000 gallons or continuous make-up feed) are required to be functionally classified as safety significant.

The specific safety basis documents submitted for review and approval to expand the applicability of liquid influent manual isolation valves are:

- Change Request Package HLW-CRF-03010 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
- CSTF TSRs, S-TSR-G-00001, Revision 2003-D

On March 14, 2003, DOE approved JCO WSRC-TR-2003-00083, Revision 0, which authorized removal of solids from Tank 50H using water or waste with an inhalation dose potential of $\leq$ 1.0E+04 rem/gal. Although solids have been removed, large volumes of inhibited water are involved in the dilution and transfer operations, which is causing large volumes of grout to be formed at the Saltstone facility. To continue the solids removal effort yet minimize the overall amount of grout stored in the Saltstone facility, while at the same time support the salt removal program in the Tank Farm, the Contractor has submitted a revision to the JCO to raise the inhalation dose potential to 2.8E+05 rem/gal. This will allow the processing of the dissolved low curie salt material in Tank 41H to Tank 50H. The JCO revision also removed the requirement that incoming feed to Tank 50H have $\leq$ 0.93% uranium enrichment. A Nuclear Criticality Safety Evaluation (NCSE) was issued, and referenced in the revised JCO, to show that solid formation in Tank 50H will not represent a criticality concern given the U^{235} enrichments possible in Tank 50 and if all the plutonium is Pu^{239}.

2.0 Background

The submitted changes to the safety basis in Reference 2 do not alter the purpose, mission, or Hazard Category of the CSTF. DOE CSTF SER Revision 0 (Reference 1) remains applicable for these topics. Tank 41H has been targeted for providing the initial batch of Low Curie Salt to Saltstone. Interstitial liquid removal has been in progress in Tank 41H for the past several months. Upon completion of the interstitial liquid removal, the saltcake in Tank 41H will be dissolved and the plan is to transfer this material to Tank 50H prior to transfer and processing at Saltstone. To provide operational flexibility for conducting this, and future, transfers, a transfer jumper is being

installed within the 242-16H evaporator cell, utilizing the cell as a secondary containment and leak detection location (similar to a diversion box). The SB changes submitted provide an evaluation of the safety impacts of allowing a transfer through this separate transfer jumper within the cell with simultaneous evaporator operation. The SB changes include 242-16F Evaporator cell, but do not include the 242-25H Evaporator cell since simultaneous transfer/evaporator operation through this cell is not intended/envisioned.

Additionally, subsequent to DOE approval of the DSA and TSRs in Reference 1, a proposal to use well water as a direct liquid source into a waste tank was considered. The DSA and TSRs analysis for waste tank overflow only considered inhibited water and controls derived were described for inhibited water supplies since this was the facility configuration. The DSA and TSRs were clarified to require the same control (safety significant manual isolation valves) for any large source (i.e., ≥ 15,000 gallons) of non-waste liquid (e.g., well water, inhibited water, etc.).

To support transferring the dissolved saltcake in Tank 41H to Tank 50H, the current JCO had to be revised to increase the allowable dose potential limit of material transferred into Tank 50H. To support Tank 41H material and to provide some level of flexibility, the allowable limit was increased from 1.0E+4 rem/gal to 2.8E+5 rem/gal. Additionally, reference was made to a new NCSE to justify removing the restriction of maintaining ≤ 0.93% uranium enrichment in the feed transferred into Tank 50H. Because of the scope of these changes, this SER supplement incorporates all applicable DOE evaluations from SER Supplement 1 related to the Tank 50H JCO.

3.0 Review Process

This SER supplement (Supplement 4) is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

The Review Team members are shown in Attachment A, along with their review responsibility.

4.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, and the various DSA sections were consistent. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 (Reference 1) were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs: (1) are clear with respect to process area applicability; (2) provide adequate justification to support Limiting Conditions for Operation

(LCO) conditions, actions and surveillance requirements; (3) provide clear administrative controls; and (4) are consistent with the accident descriptions and credited controls.

The JCO revision was reviewed to ensure the increased consequences due to the increased allowable dose potential were acceptable (i.e., well within the applicable Evaluation Guidelines) and that appropriate controls were identified to minimize the likelihood of experiencing these consequences. Additionally, the JCO revision to remove the restriction of maintaining $\leq$ 0.93% uranium enrichment in the feed transferred into Tank 50H was reviewed to ensure there was a sound technical basis consistent with DOE-STD-3007 for this relaxation.

5.0 Evaluation

5.1 242-16F and –16H Evaporator Cell Transfer Jumper

DSA section 2.4.2 was appropriately revised to recognize that the 242-16F and –16H Evaporator cells can be used as secondary containment for waste tank to waste tank transfers directly through the cells (i.e., through a transfer jumper that does not involve going into/out of the evaporator pot).

Waste transfers through the evaporator cells via the transfer jumper are limited in source term to less than or equal to 9.8E+07 rem/gal (which is the limit for Bounding Supernate in DSA Section 3.4.1.5.1). In addition, steam jet transfers with a radiolytic hydrogen generation rate of > 9.6E-06 cubic feet of hydrogen per hour per gallon (ft^3/hr/gal) are prohibited through the evaporator cell transfer jumper. These restrictions will ensure that the consequences associated with the various DSA accidents affected (discussed below) are not exceeded.

The 242-16F/16H evaporator cells were added to the General Controls DSA Section 3.4.1.5.6 for the Secondary Containment Waste Control program to ensure the hydrogen concentrations are within the assumed values. A residual waste volume was determined and added to the DSA Table 3.4-4 that would result in an equilibrium hydrogen concentration of 25% LFL assuming atmospheric breathing as the only hydrogen removal mechanism in the cell vapor space (i.e., no active ventilation considered). This is consistent with other secondary containments within CST Facilities.

Reference 3 was developed to document the accident analysis for a non-evaporator related transfer line spill and leak in the 242-16H/16F evaporator cells. Reference 4 addresses transfer line spills and leaks in valve boxes, diversion boxes, and pump pits as well as overflows and above-ground pipe breaks/leaks, which was previously reviewed by DOE in Reference 1. Reference 3 uses the same methodology and model as Reference 4 in determining event consequences. Reference 3 concludes the 100 meter dose from a transfer jumper spill of 15,000 gallons inside the evaporator cell (using 9.8E+07 rem/gal material) is 13.1 rem. Reference 4 shows the worst case 100 meter dose of a contained spill of 15,000 gallons is 142 rem (using 1.5E+09 rem/gal material). Reference 4 used a spill height of 3 meters for the diversion boxes based on their configuration. Reference 3 used a spill height of 8 meters for the evaporator cells based on their configuration. This affects the Airborne Release Fraction (ARF); the ARF using the evaporator cell height is ~15% increase. By ratioing the inhalation dose potential difference, and accounting for the increased ARF, DOE used Reference 4 and derived a rough estimate for the 100 meter dose of 11 rem. Thus, the consequences calculated in Reference 3 seem reasonable and consistent.

The significantly affected accident scenarios from waste transfers through the transfer jumper and simultaneous evaporator operation are as follows:

5.1.1 Evaporator Pot Explosion (3.4.2.1)

The accident progression was revised to recognize the potential transfer through the evaporator cell and that the evaporator pot explosion could cause the transfer jumper to leak/break. Thus, the consequences of the transfer jumper leak/break (<0.1 rem offsite; 13.1 rem onsite), determined in Reference 3, must be added to the consequences of the 242-16F or –16H evaporator pot explosion (<0.1 rem offsite; 10.4 rem onsite). However, this combination is still less than the 242-25H Evaporator explosion by itself (<0.1 rem offsite; 40 rem onsite). These resulting event consequences do not challenge the EG's (25 rem offsite; 100 rem onsite). Therefore, no additional controls beyond the general controls are required.

5.1.2 Evaporator Cell Explosion (3.4.2.2)

The accident progression was revised to recognize a leak from either the evaporator system or from the transfer jumper which could lead to a cell explosion. Consistent with the methodology used for other transfer facilities (given in DSA section 3.4.1.5.2), the transfer jumper leak results in a maximum of 15,000 gallons of waste in the cell. The explosion damages both the evaporator pot and the transfer jumper. For an explosion initiated by the transfer jumper leak, the event was considered bounded by an HDB-7 transfer facility explosion since the analysis for HDB-7 uses a much larger hydrogen generation rate and the evaporator cell size is larger than HDB-7. This results in a longer time to reach 100% LFL in the evaporator cells. The basis for this comparison is documented in Reference 5. The analysis in DSA section 3.4.2.7 for HDB-7 concluded that the vapor space did not reach 100% LFL. Thus, by comparison, the 242-16F and –16H evaporator cells would not reach 100% LFL from a leak in the transfer jumper. However, a slow leak into the evaporator cell from the evaporator system, which is already analyzed in DSA section 3.4.2.2, does cause the cell to exceed 100% LFL. Thus, this postulated explosion is assumed to damage the transfer jumper, resulting in spilling 15,000 gallons of waste into the cell. Therefore, consequences due to a slow leak from the evaporator system into the cell now must include the explosion consequences and the consequences from the resulting transfer jumper failure. The total consequences offsite remain <0.1 rem, but the onsite consequences changed from 0.6 rem to 13.7 rem, still well below the EGs.

5.1.3 Evaporator Overflow, Leaks, and Spills (3.4.2.3)

The accident scenario was revised to recognize a leak from the transfer jumper. The consequences from this new leak potential were derived in Reference 3 using the methodology consistent with the methodology in Reference 4 discussed in DSA section 3.4.2.9 for other transfer facilities. The resulting consequences (<0.1 rem offsite and 13.1 rem onsite) were appropriately reflected in section 3.4.2.3.4.

5.1.4 Seismic Event (3.4.2.18)

The accident scenario was revised to recognize the impact of a leak from the transfer jumper in the 242-16F and –16H Evaporator cells. The DSA approved by DOE in Reference 1 concluded that core pipes/jumpers needed to be safety class due to the impact leaks would have on the cumulative post-seismic offsite dose given the potential to transfer bounding sludge-slurry (1.5E+09 rem/gal) material. Given the restriction in inhalation dose potential (9.8E+07 rem/gal) allowed through the transfer jumper in the 242-16F and –16H Evaporator cells, this transfer jumper is only committed to be safety significant. Thus, it is qualified to survive and protect onsite personnel and its failure does

not contribute to the cumulative onsite doses from a Seismic event. For offsite consequences, failure of this transfer jumper is postulated and the resulting consequences are included. As discussed in DSA section 3.4.2.18, the worst case events in the evaporator cells are over-pressure events in all three evaporators (already postulated and analyzed in DSA section 3.4.2.18) in conjunction with a leak from the transfer jumpers in both the 242-16F and –16H Evaporator cells. The cumulative dose from all of these evaporator related events is still < 0.1 rem offsite, so the total offsite consequence reported in section 3.4.2.18.4 is unchanged.

5.1.5 Miscellaneous DSA Impacts

Other DBAs were properly clarified (no additional analyses required) to reflect the new transfer jumper utilization through the 242-16F and –16H Evaporator cells (e.g., Core Pipe Explosions in DSA section 3.4.2.6, Transfer Facility Explosions in DSA section 3.4.2.7, Transfer Error in DSA section 3.4.2.9, etc.).

Two of the Beyond DBA (BDBA) events were affected, Large Liquid Waste Release and Secondary Containment Explosion. The Large Liquid Waste Release BDBA was revised to reflect that the analyzed spilling of 100,000 gallons of bounding sludge slurry (inhalation dose potential of 1.5E+09 rem/gal) in various transfer facilities bounds spilling even 1,000,000 gallons of bounding supernate (inhalation dose potential of 9.8E+07 rem/gal) in the 242-16F and –16H Evaporator cells. The Secondary Containment Explosion BDBA was revised to show that the worst case explosion in the 242-16F or –16H Evaporator cell was approximately 5 rem (compared to ~ 3 rem in other transfer facilities) and to reflect that the subsequent spilling of even 1,000,000 gallons of bounding supernate in the 242-16F and –16H Evaporator cells would result in a combined consequence of approximately 8 rem (compared to current worst case combination of ~ 6 rem). Thus, no additional safety class controls are warranted.

DOE review of the proposed changes found all the DSA sections modified (e.g., Chapters 2, 3, 4, and 5) to be internally consistent and compliant with the criteria in DOE-STD-3009.

5.1.6 TSR Revisions

The TSRs were modified to include a new LCO (3.7.12) similar to existing LCO 3.7.2 for Diversion Boxes. This new LCO, similar to existing LCO 3.7.2, is to protect the initial assumption used in the evaporator cell explosion event (DSA section 3.4.2.2) initiated by the transfer jumper leak. Leakage from the evaporator system (feed line, pot, lift line) is analyzed in the existing DSA which shows that the evaporator cell explosion consequences do not challenge the onsite or offsite EGs. The initial condition used for the existing evaporator system leak scenario is that the evaporator cell vapor space is ~0% LFL due to the practice of always operating the cell ventilation system whenever the evaporator pot is operating, the large size of the cell, the large flowrate provided by the cell ventilation system, and the fact that it would take > 40 days to reach 25% LFL if cell ventilation were lost. The existing scenario progression accounts for spilling evaporator system waste into the cell until the waste overflows into the cell ventilation ductwork (equates to ~37,000 gallons for 242-16F and –16H), which would be detected by the operators via the Transfer Control Program (material balances, level monitoring, leak detection, etc.), and evaporator feeding/lifting would be terminated. Thus, no LCO was provided in the existing TSR to protect the initial condition nor to terminate evaporator operation upon detection of leakage into the cell sump. This is specifically discussed in DSA section 3.4.2.2 and accepted by DOE in Reference 1.

However, for the new scenario involving a leak from the transfer jumper which bypasses the evaporator pot, the evaporator cell ventilation may not be operating when a transfer through the transfer jumper is made (i.e., if the evaporator pot is not concurrently operating). Thus, similar to other diversion boxes, the accident scenario made the assumption that the evaporator cell vapor space would be initially at 25% LFL. Without cell ventilation operating, this is only valid if the sump level is maintained at a low level. Thus, the new LCO 3.7.12 protects this assumption by requiring the evaporator cell sump to be maintained below 664 gallons. Additionally, if the cell sump level is greater than this, the only transfer motive source which must be stopped is that pump/jet processing through the transfer jumper since this is the only source required by the accident progression to be terminated via an LCO.

The Condition statement, Required Actions, Completion Times, and the Bases for the new LCO 3.7.12 are similar to those in LCO 3.7.2. The allowable cell sump level was conservatively derived using the bounding sludge-slurry H_2 generation rate similar to Diversion Boxes. Two notable differences exist between these LCOs:

1. LCO 3.7.12 contains a "Note" that allows intentionally increasing the 242-16F and –16H Evaporator cell sump level above the limit (allows 300 additional gallons of waste and up to a total of 5000 gallons of liquid to be added to the sump and allows this condition up to 7 days); and
2. the Completion Time for verifying H_2 concentration in the cell or purging the cell is 7 days versus 24 hours.

Both of these differences are justified based on the fact that the allowable H_2 generation rate through the 242-16F and –16H Evaporator cells is much lower than the bounding H_2 generation rate used for the Diversion Boxes. Reference 5 shows that the allowance in the "Note" could result in the cell vapor space increasing from an initial equilibrium concentration of 25% LFL to a ~29% LFL. As discussed above, spilling 15,000 gallons of bounding supernate into the 242-16F or –16H Evaporator cell would not cause the cell vapor space to reach 100% LFL in 10 days. In fact, Reference 5 shows that the resulting concentration would be < 80% LFL. Thus, even if the additional waste/liquid allowed by the Note occurred and a subsequent 15,000 gallons of waste spilled into the cell, the cell vapor space would not reach LFL in 10 days. Thus, the 7 day allowance in the Note and in the Completion Time is appropriate and adequate.

Required Action A.1 in the new LCO 3.7.12 only requires stopping the waste transfer going through the evaporator cell which bypasses the evaporator pot (i.e., upon detection that liquid in the cell sump is above the allowable value, transfers to/from the evaporator pot are not required to be stopped). This is justified since simultaneous leakage from both the evaporator system and the separate transfer jumper is not postulated. As discussed above, the existing accident progression for leaks from the evaporator system does not require an LCO to terminate evaporator feed/lift upon detection of the leak in the evaporator cell.

The TSR Administrative Control section for prohibited activities (5.8.2.43) was also revised to capture the prohibitions on transferring > 9.8E+07 rem/gal material and on conducting steam jet transfers of waste with a H_2 generation rate > 9.6E-6 ft^3/hr/gal through the evaporator cell transfer jumpers.

DOE review of the proposed changes found the TSR revisions to be internally consistent, consistent with the derivation in the DSA, and compliant with the criteria in DOE Guide G 423.1-1.

5.2 Liquid Influent Manual Isolation Valves

DSA section 3.4.2.9 was clarified to describe the prevention of overflowing a waste tank as requiring manual isolation valves on any non-waste liquid source ≥ 15,000 gallons (i.e., if a vessel capacity is <15,000 gallons and has no continuous makeup capability, this requirement does not apply). DSA chapters 4 and 5, as well as TSR Table 6.1, were clarified accordingly. These revisions do not change the event frequency, consequences, risk, or margin of safety, or the intent of the original control strategy. DOE found these clarifications appropriate and adequate.

5.3 Tank 50H JCO Revision

Three areas of accident analyses are impacted by the solids in Tank 50H: (1) Waste Tank and Waste Tank Annulus Explosions; (2) Transfer Line and Transfer Facility Explosions; and (3) Tank 50H Criticality. Each of these areas were evaluated and approved in DOE CSTF SER Revision 0, Supplement 1, for the solids that were in Tank 50H at that time (estimated to be ~61,000 gallons (or 153 kg's of tetraphenylborate (TPB)). Since then, solids removal activities using Inhibited Water has continued and the current TPB solids volume is estimated to currently be ~ 60 kg's). Additionally, JCO Revision 0, approved in SER Supplement 1, required the material in Tank 50H and transferred into Tank 50H to be ≤ 1.0E+04 rem/gal and have ≤ 0.93% uranium enrichment. The ultimate goal of the activities allowed by the existing and revised JCO is to remove sufficient solids from Tank 50H such that the impact from the TPB solids meets the current DSA requirement of < 5% LFL at 100°C. To continue the solids removal effort yet minimize the overall amount of grout stored in the Saltstone facility, while at the same time support the salt removal program in the Tank Farm, the Contractor has submitted a revision to the JCO to raise the inhalation dose potential to 2.8E+05 rem/gal. This will allow the processing of the dissolved low curie salt material in Tank 41H to Tank 50H. The JCO revision also removed the requirement that incoming feed to Tank 50H have ≤ 0.93% uranium enrichment based on a new NCSE. Thus, each of the accident analyses impacted by the solids in Tank 50H are re-evaluated below.

5.3.1 Waste Tank and Waste Tank Annulus Explosions

The current CSTF DSA assumes a 5% maximum contribution to vapor space LFL from organics. However, due to the TPB solids in Tank 50H and the potential for chemical degradation of TPB creating benzene in amounts larger than allowed in the DSA, protecting 7 days to LFL cannot be determined with certainty. Thus, the JCO is necessary until such time as sufficient solids have been removed that the CSTF DSA assumption regarding organic impacts to the LFL is satisfied.

The CSTF DSA, section 3.4.2.11, concludes that an explosion in a waste tank must be prevented. This conclusion was based on the potential consequences exceeding the offsite and onsite Evaluation Guidelines using bounding waste (sludge-slurry representing 1.5E+9 rem/gal inhalation dose potential). The waste within Tank 50H is well below this bounding waste; calculation X-CLC-H-00354 shows <1E+04 rem/gal. Reference 7 was prepared to show the consequences from a Tank 50H explosion using the same methodology employed in DSA section 3.4.2.11, which DOE approved in Reference 1. The consequences in Reference 7 used waste with an inhalation dose potential of 2.8E+05 rem/gal, which bounds the waste in Tank 50H (calculation X-CLC-H-00354 shows <1E+04 rem/gal). The resulting offsite radiological consequences of a Tank 50H explosion would be about 60 mrem and the onsite (100 meter) consequences would be about 25 rem. These values are well below the Evaluation Guidelines (EG) in DOE-STD-3009 of 25 rem offsite and the current WSRC Manual E7, Procedure 2.25, EG of 100 rem onsite. These consequences take into account the potential contribution from benzene, which has a higher heat of combustion than

hydrogen, by utilizing results from the DWPF DSA (WSRC-SA-6). Table 9.4-4 of the DWPF DSA shows a benzene explosion would aerosolize < 20% more than a hydrogen explosion. The consequences reported in Reference 7 assumed a 100% increase for conservatism.

Because the consequences for an explosion in Tank 50H are well below the EGs for an Anticipated event, no prevention or mitigation is required other than protecting assumptions for consequence determination (e.g., inhalation dose potential of material in the tank). The JCO requires the material in Tank 50H to be maintained less than 2.8E+05 rem/gal and prohibits transfers of any material to Tank 50H which would cause the inhalation dose potential of the resulting Tank 50H waste to be greater than 2.8E+05 rem/gal. Verification of incoming feed meeting this dose potential limit can be based on the Waste Characterization System (WCS). The WCS information on sending tanks (e.g., Tank 41H) is not necessarily based on representative samples, but rather process history. Thus, some level of uncertainty exists as to what the incoming feed material dose potential (rem/gal) is. To compensate for this uncertainty, the JCO also requires periodic confirmation via representative sampling of the Tank 50H material. [As stated above, the conservatism within the 25 rem onsite calculated consequence compensates for this uncertainty too.] As stated above, the intent of the 2.8E+05 rem/gal limit is to ensure the material at risk upon an explosion is within the bounds of the consequence calculation. Since periodic slurrying operation will be needed to optimize solids removal, then at least some of these periodic samples will have to be associated with slurried conditions in the tank such that they are representative of the material at risk used in the tank explosion consequence calculation.

Since an explosion within Tank 50H is considered unacceptable, regardless of radiological consequences, all the controls specified in the CSTF DSA and TSRs to prevent an explosion will be maintained, with the following exceptions/clarifications:

1. Tank 50H will be designated a "Rapid Generation Tank," regardless of the calculated time to reach LFL
   [*results in more stringent ventilation and LFL monitoring controls than a Slow or Very Slow Generation Tank*]
2. Tank 50H LFL monitor will have its output response adjusted for benzene
   [*DSA/TSR requires calibration/output response for hydrogen only. Since benzene may dominate the vapor space rather than hydrogen, the adjustment for benzene is prudent. Additionally, calibrating for benzene provides a conservative response to hydrogen.*]
3. Tank 50H will not be required to enter the "Gas Release Mode" defined in the DSA/TSRs during slurry pump operation, even though, depending on the assumptions used regarding benzene retention and release, the vapor space could be shown to exceed 25% LFL due to pump operation
   [*this exclusion is necessary since Tank 50H does not have the installed equipment to meet the prerequisites to enter the Gas Release Mode. This exclusion is sufficient given*
   a. *the low consequences from a potential explosion*
   b. *the fact that the estimated benzene release rate, which was the basis for the conclusion that the 7 days to LFL may not be protected, was based on conservative extrapolation of data from testing of Tank 48H material. Tank 48H material has a significantly higher copper concentration and TPB solubility than the Tank 50H material (Reference 8) and both of these factors add to the benzene release rate.*
   c. *during the addition of waste from Tank 49H to Tank 50H in 2001 and the subsequent slurrying of that waste, elevated benzene or LFL levels were not detected in Tank 50H.*

Since that evolution concluded, routine benzene sampling in the Tank 50H vapor space has indicated less than 2 ppm.

d. *Most of the solid mounds within Tank 50H have been removed by water lancing and slurrying activities earlier in 2003, again with no elevated benzene or LFL levels detected.*

e. *the TSR LCOs require slurry pump operation to be secured (albeit allowed to be by an operator versus interlocks) if ventilation is lost or if the LFL monitor exceeds 15% LFL (accounts for instrument uncertainty to protect DSA limit of 25% LFL).*

Thus, there is full expectation that solids agitation due to slurry pump operation will not cause the Tank 50H vapor space to exceed 25% LFL.]

4. Tank 50H LFL monitor instrument uncertainty does not have to meet the 10% value in the CSTF TSR LCO (3.8.2).

   [*The existing Tank 50H LFL monitor, calibrated for benzene, has an instrument uncertainty of 12.22% LFL. Thus, when the monitor reads at the TSR LCO limit of 15% LFL, the actual vapor space may actually be at 27.22% LFL versus the DSA requirement of 25% LFL. This potential 2.22% LFL difference is considered insignificant during this JCO.*]

5. Tank 50H does not have to meet the requirement to have 7 days to reach 100% LFL upon loss of ventilation during pump operation or upon an earthquake.

   [*since there is uncertainty in how much and how fast benzene could be released due to agitation of the solids from slurry pump operation or an earthquake, it cannot be assured that at least 7 days exist before reaching 100% LFL. However, given the fact that the heat load in Tank 50H is/will remain low (incoming low curie salt has much lower heat than the high heat sludge material), significant benzene release due to mechanical agitation and/or degradation of the solids containing TPB is not expected. Thus, the ventilation and flammable gas monitoring controls are expected to ensure the Tank 50H vapor space does not reach 100% LFL, including post-seismic.*]

One potential impact of the increased allowable dose material in Tank 50H is that the resulting onsite (100m) consequence of 25 rem could challenge the cumulative onsite dose due to a Seismic Event. In DOE CSTF SER, Revision 0, Supplement 1, DOE concluded that the worst case cumulative onsite (100m) dose would be ~80 rem since not all postulated events described in DSA section 3.4.2.18.4 could actually affect a single onsite receptor. Similar to the evaluation DOE performed in SER Supplement 1 for accepting waste tanks placed in the Removed From Service (RFS) Mode, DOE assessed the postulated events in DSA section 3.4.2.18.4 against the facility layout around Tank 50H, and concluded that the worst case onsite (100m) receptor near Tank 50H would not receive > 80 rem, including the 25 rem due to the postulated Tank 50H explosion. This is due to the fact that there are no pump tanks and there are no waste tanks placed in the RFS Mode within 100m of Tank 50H. Thus, no single onsite (100m) receptor would experience > 80 rem and the basis for DOE acceptance described in SER Supplement 1 is not jeopardized.

5.3.2 Transfer Line and Transfer Facility Explosions

Transferring Tank 50H material to Saltstone poses the potential to leak and/or accumulate waste in various locations along the path (e.g., the transfer line, transfer line jacket, Tank 50H valve box, leak detection box drain cell, etc.). Under bounding waste assumptions, some of these accidents must be prevented. With the potential organic levels in the Tank 50H material, the current DSA/TSR controls are not fully adequate. Given the restriction in Tank 50H material to be ≤ 2.8E+05 rem/gal, the consequences of these accidents would be well below the offsite and onsite EGs. However, to ensure the potential accumulation of the higher organic material in Tank 50H is

confined, the JCO requires that the Tank 50H material can only be transferred to Saltstone and that the transfer path be isolated from any other CSTF location at valve WTS-V-274 within the Tank 50H valve box. This isolation point ensures no other CSTF location can receive the higher than allowed organic material. DOE reviewed drawings M-M6-H-9815 (Rev. 4), M-M6-H-8223 (Rev. 9), M-M6-H-8301 (Rev. 4), and M-M6-H-8300 (Rev. 11) and confirmed isolation at valve WTS-V-274 was appropriate and adequate to prevent inadvertent introduction of organics into any other CSTF location.

5.3.3 Evaluation of Tank 50H Solids Criticality Analysis

Analysis of the solids currently in Tank 50H found they have enrichments from 0.27 to 0.40 wt.% (References 9 and 10), which is well below the ANSI/ANS 8.1 single parameter enrichment limits applicable to uranium mixed homogeneously with water (0.93 wt.% for metal and 0.96 wt.% for oxides). The ANSI/ANS standard indicates that homogeneous mixtures had particle sizes of about 60 micrometers, whereas Tank 50H solids sample results indicate the particle sizes were less than 30 micrometers. The mounds were formed by the routine agitation of slurry pumps in Tank 50H. Based on the relatively large amount of water in the solids, the small particle size, and the low uranium content, the solids can be considered homogeneous (Reference 11). Therefore, ANSI/ANS 8.1 single parameter enrichment limits can be applied to the Tank 50H solids. The solids also contain a large amount of sodium and other neutron absorbers. Given the low uranium content, the low enrichment, and the large amount of neutron poisons, the current Tank 50H solids will remain subcritical (Reference 12).

The JCO revision allows any high level waste feed (that meets the inhalation dose potential limit defined above) into Tank 50H. Thus, enrichment controls for incoming feed no longer would apply. The JCO revision refers to the new NCSE (N-NCS-H-00165) which shows feed at any credible enrichment sorbed onto the solids in Tank 50H will not cause a criticality concern in Tank 50H . Laboratory analyses using the Tank 50H solids (WSRC-TR-2003-00114, Rev. 0) found that (1) the solids contained uranium (indicating the solids had removed U from solution while in Tank 50H), and (2) the solids would remove plutonium (Pu) and neptunium (Np) from solution. DOE reviewed the new NCSE to support Tank 50H (N-NCS-H-00165, Revision 0) and the primary supporting report (WSRC-TR-2003-00114) and identified comments necessitating revision to the NCSE. The Contractor revised the NCSE to address these comments. DOE review of the revised NCSE found that it was performed consistent with the guidelines in DOE-STD-3007. Key points were:

1. used the appropriate limits from ANS 8.1 (i.e., showed the hydrogen to fissile ratio was met for U and Pu),
2. provided adequate justification that no credible mechanism exists to dry out the solids such that the hydrogen to fissile material ratio would be invalidated,
3. provided sufficient justification that no credible mechanism exists to raise the bulk uranium enrichment in Tank 50 to levels that may challenge the hydrogen to fissile material ratio (there is actually sufficient hydrogen present in the free water to protect to enrichments up to 80%)
4. Conservatively assumed the U and Pu loading developed in WSRC-TR-2003-00114, which measured total U and total Pu, was 66% U^{235} and 100% Pu^{239}, respectively. Other conservatisms present where no credit is taken include other hydrogen present in the system (e.g., water of hydration), presence of large quantities of other neutron absorbers (e.g., sodium), or the finiteness of the system. These account for uncertainty in how much fissile material might load onto the solid matrix developed in WSRC-TR-2003-00114.

5. properly concluded that the likelihood of Np separating itself from the solid matrix, then separating itself from the surrounding waste (thus becoming completely dry) and collecting into a sphere is incredible,
6. was supportable based on appropriate laboratory experiments using actual Tank 50H solids.

To ensure the proper criticality safety basis is provided in the JCO, a **Condition of Approval** is identified in Section 6.0 below to incorporate a change in revision number for Reference 4 of the JCO (i.e., the NCSE). It is noted that the revised NCSE makes generalized statements concerning the "bounding [uranium] enrichment of the Tank Farm waste." Reference is made to a report (EDD-NMP-94-0007) supporting the 66% enrichment used in the revised NCSE. However, this report only addressed reactor charge material starting in the mid-80's. The revised NCSE recognizes that the H-Canyon has processed material at higher enrichments, but concludes the bulk enrichment is still ≤ 66%; however, no reference is given to support this conclusion. DOE reviewed reports WSRC-TR-96-0124 and HLW-STE-2002-00328 which documented the enrichments of material in Tank 41H and within the 242-1H Evaporator system (where the highest enrichment material was processed). These reports show higher enrichments in some campaigns (up to ~84%), but many campaigns having much lower enrichments than 66%. Based on these figures and the significant thermal mixing that occurs within the salt receipt tanks from evaporator operation, and the margin shown in the revised NCSE (i.e., Tank 50H material would be critically safe up to an enrichment of 80%, and assuming the uranium loading was 2-sigma above the maximum loading found in the laboratory experiments), DOE concluded sufficient information exists to demonstrate the criticality safety of Tank 50H. However, not all of this rationale is in the NCSE. Thus, the Contractor should either provide a more detailed technical basis for its assertion related to bounding tank farm enrichments or should clarify that the bounding 66% enrichment argument applies solely to Tank 50H. This is a **Revision Issue (CSTF-0-04-R1)**.

5.3.4 Exiting the JCO

Revision 1 of the JCO maintained the requirement that this JCO remain in effect until the Tank 50H contents meets the DSA requirement that organics contribute no more than 5% LFL at 100°C. However, to ensure the overall purpose of the JCO is maintained (i.e., to recover from the discovery of TPB solids in a timely manner), the exit strategy was modified to state the JCO expires after 4 million gallons of Tank 50H material has been processed through to Saltstone. As discussed earlier, it is expected that slurrying will be necessary to optimize the solids removal such that the goal of meeting the 5% LFL impact from organics will be met before 4 million gallons of total liquid is processed through Tank 50H. If 4 million gallons of Tank 50H material are processed through to Saltstone and the analysis of Tank 50H content still shows the organics contribute >5% LFL at 100°C, the JCO expires and another submittal to DOE would be required. The 4 million gallons was chosen based on an estimate of how much liquid would be needed to remove the Tank 50H solids when large batches are added to Tank 50H (current practice is to add small batches of IW). The 4 million gallons should also provide sufficient margin to allow the dissolution of the ~1 million gallons of salt cake within Tank 41H, including adjustments to meet the Saltstone sodium molarity requirements.

Based on the DOE review and evaluation above, DOE concluded the analyses and controls in JCO WSRC-TR-2003-00083, Revision 1, are adequate to prevent and mitigate potential hazards due to the existence, agitation, and transfer of the Tank 50H solids material.

6.0 Conditions of Approval

Revise Reference 4 (N-NCS-H-00165) of the JCO to Revision 1.

7.0 Conclusions

Based on the evaluation documented in Section 5.0 of this SER supplement, DOE review of the SB changes concludes the hazards associated with the Design Basis Accidents have been identified and the appropriate SB controls applied to protect the onsite workers, the general public, and the environment. Therefore, the proposed changes submitted in References 2 and 6 are approved. DOE also identified one Revision Issue, as discussed in section 5.3.3.

8.0 References

1. Letter, Allison to Pedde, DOE CSTF SER Revision 0 for CSTF DSA/TSR, PC-03-008, 12/20/02.
2. Letter, Johnson to Anderson, "Submittal of Tank 41 to Tank 50 Safety Bases Revision to DOE for Review and Approval," CBU-LWD-2003-00038, 5/7/03.
3. Calculation S-CLC-G-00295, Rev. 0, "Non-Evaporator Transfer Line Spills & Leaks in 2F/2H Evaporator Cells."
4. Calculation S-CLC-G-00236, Rev. 0, ""Transfer Errors, Overflows, Spills, Breaks, Leaks, Siphons, and Vehicle Crashes in the CST Transfer Facilities."
5. Memorandum, Mullaney to Schwenker, "Comparison of Cell Explosions between HDB-7 and 242-16F/16H," WSMS-LIC-M-03-0017, 5/5/03.
6. Letter, Johnson to Anderson, "Submittal of Revision 1 of the Concentration, Storage, and Transfer Facilities Justification for Continued Operations (JCO) to DOE for Review and Approval," CBU-LWD-2003-00045, 5/15/03.
7. Memorandum, Webb to Selvey, "Evaluation of Tank 50 Airborne Release Accidents," WSMS-LIC-03-00048, Rev. 1, 5/14/03.
8. KTPB Decomposition Rate During Slurrying of Solids in Tank 50H, SRT-LWP-2003-00019, 2/4/03.
9. Results of Sample Analysis from Solids Removed from Tank 50H, WSRC-TR-2002-00506, 10/31/02.
10. Results of Sample Analysis of Tank 50H South Mound Solids, WSRC-TR-2003-00068, 1/20/03.
11. Uniformity of Solids in Tank 50, WSMS-CRT-03-0019, 2/13/03.
12. Criticality Safety of Solids in Tank 50, WSMS-CRT-02-0089; 11/1/02

ATTACHMENT A
Review Team Members

Team Member	Organization	Area of Review Responsibility
Tom Temple	HLW-ED	Lead Reviewer and SER Preparer
Don Blake	HLW-ED	Support Reviewer and SER Preparer
Sue Aleman	HLW-OD	Tank 50H NCSE Reviewer
Glenn Christenbury	NM-ED	Tank 50H NCSE Reviewer
Dave Faubert	HLW-ED	Independent SER Technical Reviewer

JUN 1 3 2003

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Transmittal of Tank 30 Response Plan (Letter, Johnson to Anderson, CBU-LWD-2003-00049)

The Department of Energy (DOE) has reviewed the subject Response Plan (RP-HTF-2003-001) submitted by the referenced letter and approves this Response Plan. The enclosed Safety Evaluation Report (SER), Revision 0, Supplement 5, documents the basis for approval.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or your staff may contact Tom Temple at 208-8772.

Sincerely,
Original Signed By
Jeffrey M. Allison
Jeffrey M. Allison
Manager

PA-03-031

Enclosure:
CSTF SER Supplement 5

cc w/encl:
W. J. Johnson, WSRC, 703-H
D. B. Little, WSRC, 703-H

cc w/o encl:
H. T. Conner, Jr., WSRC, 730-1B
L. J. Hollick, WSRC, 703-A
W. S. Elkins, WSRC, 730-B
M. D. Johnson, WSRC, 703-H

bc w/encl:
T. C. Temple, ED, 707-H
D. J. Blake, ED, 707-H
J. A. Smartt, EAD, 730-B

bc w/o encl:
MGR Rdg File
AMHLW Rdg File
ECAT, 703A
ED Rdg File
IMS

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 5

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF RESPONSE PLAN RP-HTF-2003-001
Less than Seven Days to Go from 25% to 100% LFL on Tank 30

June 2003

Prepared by : Thomas C Temple
Thomas C. Temple

Reviewed by: _____
Dave Faubert

Approved by: Jean M. Ridley
for Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR HIGH LEVEL WASTE
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 5

1.0 Introduction

On June 12, 2003, a determination was made that Tank 30H did not have the requisite time, upon loss of ventilation, to go from 25% to 100% of the Lower Flammability Limit (LFL). The current CSTF Documented Safety Analysis (DSA) and Technical Safety Requirements (TSRs) require all waste tanks to have at least 7 days to go from 25% to 100% LFL due to radiolytic hydrogen generation upon loss of ventilation. The results of a calculation performed for Tank 30H using the methodology described in the DSA showed approximately 4 days. Thus, Tank 30H was outside the DSA and TSR Administrative Control (AC) section 5.8.2.27 (Flammability Control Program). In accordance with TSR section 5.4 and Limiting Condition for Operation (LCO) 3.0.3, WSRC prepared and submitted Response Plan RP-HTF-2003-0001 (Reference 1) to DOE to provide the necessary compensatory measures to maintain Tank 30H in a safe condition until Tank 30H can be restored to compliance with the DSA and TSR requirements.

2.0 Background

On June 12, 2003, corrosion control sample results were confirmed to show that the nitrate (NO_3) and nitrite (NO_2) levels in the Tank 30H supernate had reduced substantially from the previous sample, causing the H_2 production rate to be such that the time to go from 25% to 100% LFL was calculated to be ~4 days. The mechanism causing the substantial reduction of NO_3 and NO_2 is due to the fact that Tank 30H had been filled with hot, high salt content concentrate from the 242-25H Evaporator, then allowed to cool over time (since this drop tank was made idle and Tank 37H was made the 242-25H drop tank). Cooling of this high salt content concentrate caused the sodium NO_3 and sodium NO_2 to precipitate out of solution. Note that, although the reduced NO_3 and NO_2 levels have caused Tank 30H to be outside the Flammability Control Program, the tank is still within the Corrosion Control Program requirements.

The methodology for determining the time to go from 25% to 100% LFL described in the DSA includes:

1. using the radioactive decay heat load in the tank.
2. using the nitrate (NO_3) and nitrite (NO_2) concentration in the tank (these species scavenge hydrogen molecules generated from radiolysis of water such that the net production of H_2 into the vapor space is reduced).
3. using the vapor space in the tank above the High Liquid Level Conductivity Probe (HLLCP).
4. accounting for the addition of 15,000 gallons of waste above the HLLCP setpoint.

Using this methodology, with the lower NO_3 and NO_2 concentrations, resulted in calculating ~4 days as the time to go from 25% to 100% LFL in Tank 30H, upon loss of ventilation. Since this is less than 7 days and the DSA/TSR controls are based on having at least 7 days, then a Response Plan was needed per TSR sections 1.2 and 5.4.

Tank 30H still has 7 days to go from 25% to 100% LFL post-seismic, including the effects of trapped gas release. The DSA methodology for performing this calculation allows use of the vapor space based on the actual level in the tank versus above the HLLCP. With the current liquid level in the tank, even including the trapped gas release, the post-seismic time to go from 25% to 100% LFL is greater than 7 days. Since the Response Plan prohibits all waste additions to Tank 30H and

only allows minimal water additions (e.g., for sampling, for equipment flushing, etc.) or chemical additions to restore compliance with the Flammability Control Program in TSR AC 5.8.2.27, this SER supplement does not evaluate this aspect of the Flammability Control Program any further.

3.0 Review Process

This SER supplement (Supplement 5) is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

4.0 Review Criteria

Response Plan RP-HTF-2003-0001 was reviewed to ensure it provided compensatory measures such that the risk of storing waste in Tank 30H was equivalent to the risk utilizing the DSA and TSR controls. Additionally, the bases for these compensatory measures were reviewed to ensure there was adequate justification.

5.0 Evaluation

Tank 30H is currently designated a Rapid Generation Tank (RGT) since it had a calculated time to go from 25% to 100% LFL of less than 28 days but $\geq$ 7 days (even before the reduction in NO_3 and NO_2 occurred). The control strategy derived in the DSA and TSRs for RGTs was to ensure each waste tank had at least 7 days to go from 25% to 100% LFL (utilizing the vapor space above the HLLCP only), require continuous LFL monitoring of the tank vapor space, and require continuous ventilation flow. Surveillance Requirement (SR) frequencies were set up in TSR LCOs 3.8.1 and 3.8.2 to ensure loss of ventilation flow or elevated H_2 concentration were detected in time such that recovery actions could be accomplished within 7 days so that the tank vapor space would not reach LFL (thus, preventing an explosion). Given the fact that Tank 30H does not have the requisite 7 days using the vapor space above the credited safety class HLLCP, Response Plan RP-HTF-2003-001 identifies the following compensatory measures:

1. All liquid additions into Tank 30H are prohibited, except minimal water additions (e.g., for sampling, for equipment flushing, etc.) or chemical additions to restore compliance with the Flammability Control Program in TSR AC 5.8.2.27. Additionally, the Tank 30H cooling coils are required to be isolated since these coils have leaked in the past; and cooling water supply to the coils is not a credited safety function in the DSA.
2. Operational/maintenance/construction activities on Tank 30H are permitted as long as they do not cause installed purge ventilation system to become inoperable or they do not impede ability to perform the surveillances within the Response Plan.
3. Weekly ensure Tank 30H has at least 10 days to go from 25% to 100% LFL by ensuring adequate vapor space volume. Using the current liquid level in Tank 30H, the current time is ~14 days. This compensatory measure will require, weekly, verification that the liquid level in the tank has not increased (due to the allowable water additions in item 1 above) to the point where the time to go from 25% to 100% LFL is less than 10 days. This level verification will be conducted using the installed reel tape or by steel taping. These methods do not have uncertainty calculations performed. However, given compensatory measure 1 above and the protection of 10 days, versus 7 in the current DSA/TSR, verifying the level using either of these methods every week is acceptable.

4. Perform TSR SR 4.8.1.1 (verifies adequate ventilation flow) every 12 hours (current SR frequency is 24 hours). Given compensatory measures 1-3 above, this reduction in frequency is appropriate and adequate.
5. Perform TSR SR 4.8.2.2 (verifies H_2 concentration in tank vapor space is < 15%) every 12 hours (current SR frequency is 24 hours). Given compensatory measures 1-3 above, this reduction in frequency is appropriate and adequate.

One assumption that is inherent in the calculation for compensatory measure 3 above is that the low concentrations of NO_3 and NO_2 in Tank 30H do not reduce any further. DOE concluded that using the values from the 3/28/03 sample was acceptable because:

1. Response Plan RP-HTF-2003-001 is only valid for 30 days;
2. Cooling water will be isolated to Tank 30H, thus reducing heat removal;
3. Temperature trends in Tank 30H show the temperature associated with the low concentrations of NO_3 and NO_2 is approximately the same as the expected equilibrium temperature that Tank 30H will stay at while under the Response Plan.

6.0 Conditions of Approval

None.

7.0 Conclusions

Based on the evaluation documented in Section 5.0 of this SER supplement, DOE review of Response Plan RP-HTF-2003-001 concludes the appropriate safety basis controls are identified to protect the onsite workers, the general public, and the environment to an equivalent level of protection as afforded in the current DSA and TSRs. Therefore, the Response Plan submitted in Reference 1 is approved.

8.0 References

1. Letter, Johnson to Anderson, "Transmittal of Tank 30 Response Plan," 6/13/2003, CBU-LWD-2003-00049

AUG 2 7 2003

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Submittal of Tank 3 Safety Bases Revision to DOE for Review and Approval, CBU-LWD-2003-00051 (Letter, Johnson to Hansen, 7/30/03)

The Department of Energy (DOE), Savannah River Operations Office has reviewed the Tank 3 Safety Bases Revision submitted in the referenced letter. DOE approves this safety bases revision. The enclosed Safety Evaluation Report (SER) documents the basis for approval. You are requested to take action to add this safety bases revision to the Safety Basis Document List within 90 days of the date of this letter. This action has been discussed with your staff.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please call me or your staff may call Don Blake at 208-8245.

Sincerely,

Original signed by
Charles E. Anderson
for Jeffrey M. Allison
Manager

WDED:TT:kl

DC-03-011

Enclosure:
SER for Tank 3

cc w/encl:
H. T. Conner, Jr., WSRC, 730-1B
L. J. Hollick, WSRC, 730-1B
W. S. Elkins, WSRC, 730-1B
W. J. Johnson, WSRC, 703-H
W. Matthews, WSMS, 241-254H

bc w/encl:
T. C. Temple,WDED
D. J. Blake,WDED
T. Tran,WDED
J. A. Smartt, SRPD, 730-B
R. J. Hardwick, (EH-2), HQ
bc w/o encl:
ED Rdg File
AMWDP Rdg File
MGR Rdg File
DMC, DMB Rdg File
ECAT
IMS

Enclosure: Letter, Allison to Pedde, "Submittal of Tank 3 Safety Bases Revision to DOE for Review and Approval, CBU-LWD-2003-00051," Dated" AUG 2 7 2003

SAFETY EVALUATION REPORT
REVISION 0 SUPPLEMENT 6

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

DOE-SR Safety Evaluation Report for Tank 3 Safety Bases Revision

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2003-E

August 2003

Prepared by: Tam Tran, Donald J. Blake
Tam Tran/Donald J. Blake

Reviewed by: Thomas C. Temple
Thomas C. Temple

Approved by: Michael A. Mikolanis
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

Executive Summary

WSRC submitted Technical Safety Requirements (TSR) changes to facilitate the installation of additional safety class ventilation flow and safety significant hydrogen monitoring interlocks. This equipment is needed to enable Tank 3 to be operated in the Gas Release Mode.

Tank 3 saltcake will be drained and dissolved, using technical experience learned from Tank 41 waste removal and from Hanford waste removal, to provide initial feed to the Actinide Removal Process (ARP) Facility. Safety calculation (Ref. 7) indicates interstitial liquid removal would require Tank 3 to be operated in the Gas Release Mode. Partial vapor pressure changes due to waste transfer operation and dissolution of saltcake will cause the release of trapped hydrogen, which must be limited to 25% Lower Flammability Limit (LFL) per the Documented Safety Analysis (DSA). The new modifications are needed to support this waste removal operation.

TSR changes reflect a high hydrogen interlock setting at 15% LFL, which is less than the DSA limit of 25% LFL, to account for instrumentation uncertainty of the interlock equipment. This 15% LFL setting is deemed adequate as documented in the previous instrumentation uncertainty calculation and accepted by DOE in SER Revision 0.

The TSR changes for Tank 3 saltcake draining (interstitial liquid removal) and saltcake dissolution are deemed acceptable for approval as they are fully consistent with the derivation in the DSA.

For the TSR changes other than associated with the Tank 3 interlocks, the changes were editorial/non-technical with no change in technical content of the TSR.

No Conditions of Approval were identified during this review.

1.0 Introduction and Background:

- *Use of Tank-3* – Tank 3 saltcake will be drained and dissolved, using technical experience learned from Tank 41 waste removal and from Hanford waste removal, to provide initial feed to the Actinide Removal Process (ARP) Facility. ARP supports the overall goal of removal, treatment, and disposal of salt waste currently stored in the HLW tank farms.

- *Design Change Proposal for Tank 3* – due to interstitial liquid removal and subsequent salt dissolution activities, Tank 3 will be operating in the Gas Release Mode. During this mode of operation, there exists the potential for releasing entrained hydrogen from the tank contents. Without proper ventilation and appropriate valve/pump interlocks, the concentration of hydrogen within the tank vapor space could reach flammable concentrations.

- *TSR Changes* - TSR changes are needed to support operation of new equipment being installed for interstitial liquid removal and salt-dissolution operations in Tank 3 (this will include installation and functional testing of new alarms, valves/pump interlocks, and hydrogen sensor systems/ventilation interlock to support waste removal operation for Tank 3 (F area). The waste removal operations involve pumping out the residual liquid (interstitial-liquid), then dissolving and pumping out the remaining salt-solids. Both operations would

release hydrogen as described in DSA Chapter 3, Section 3.4.2.11, "Waste Tank Explosion" scenario.

- *Hydrogen generation* - Hydrogen is generated via radiolytic-hydrolysis of water and the hydrogen is trapped/dissolved (soluble) in the salt/liquid. Partial vapor pressure changes due to waste transfer operation and dissolution of saltcake will cause the release of trapped hydrogen. To mitigate hydrogen build-up, a safety class ventilation system (and associated alarm-valve-interlocks) and a safety-significant hydrogen monitoring system (and associated alarm-valve-interlock) are credited in the DSA. TSR changes are needed to facilitate the operation of these systems. The technical bases for these TSR changes are provided in DSA chapter 3 (accident analysis, tank-explosion), and the links between the DSA and TSR are listed in DSA chapter 5 (Derivation of TSR). The uncertainty analyses are included in the TSR technical bases and listed as references in the Bases section.

- *Uncertainty analyses* – Consistent with the commitment in TSR section 1.2, uncertainty analyses were performed addressing the Tank 3 ventilation flow interlock and high LFL interlock. These analyses were performed in accordance with industry standard ANSI/ISA-67.04.01-2000.

- *Safety calculations* - There are 2 recent calculations addressing Tank 3 gas release: U-CLC-G-00013 and U-CLC-G-00014. There are 2 calculations supporting the TSR change: J-CLC-F-00317, Rev. 0 (ventilation flow uncertainty) and J-CLC-G-00048, Rev. 5 (LFL monitor uncertainty analysis).

The proposed changes (Rev. 2003-E) to the CSTF TSRs, S-TSR-G-00001, to address the above requirements for Tank 3 were submitted to DOE for review and approval in Reference 8. These submitted changes to the safety basis do not alter the purpose, mission, or Hazard Category of the CSTF. DOE CSTF SER Revision 0 remains applicable for these topics.

This SER supplement (Supplement 6) is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Documented Safety Analyses," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight." The Manager, SR, is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A.

2.0 Review Criteria:

The principal review criteria used is from DOE-STD-3009, in particular Chapter 5, Derivation of TSRs, and DOE Guide G423.1-1, Implementation Guide for Use in Developing Technical Safety Requirements. Specifically, DOE performed the following:

- Review for consistency between the accident analysis (accident scenarios) results and the technical bases of the TSR.

- Review for preservation of safety margins from DSA and bases as listed in LCO and Set Points.

- Review for adequate incorporation of uncertainty analysis

- Review for adequate redundancy of systems assumed in DSA and consistent incorporation in TSR.

3.0 Evaluation:

3.1 Tank 3 Evaluation:

Waste Storage Tanks Modes (Ref. 2, Section 5.4.3, p. 5.4-6). The waste storage tanks have two operating modes: Operation (transfer and storage of waste that do not affect bulk quantities of sludge or saltcake) and Gas Release (higher mode). Gas Release Mode is defined as follow:

1. Agitation of bulk quantities of sludge is permitted. Bulk quantities of sludge is that amount of sludge that, when agitated, has the potential to release sufficient trapped gas to exceed 25% of the hydrogen LFL, assuming no ventilation. The potential release quantity is determined by engineering evaluation. The requirements of the Pump Run Program shall apply in this mode.
2. Dissolution of bulk quantities of saltcake is permitted. Bulk quantities of saltcake is that amount of salt that has the potential to release sufficient trapped gas to exceed 25% of the LFL, assuming no ventilation. The potential release quantity is determined by engineering evaluation. The requirements of the Salt Dissolution/Interstitial Liquid Removal Program shall apply in this mode.
3. Removal of interstitial liquid from bulk quantities of saltcake is permitted. Bulk quantities of saltcake is that amount of salt that has the potential to release sufficient trapped gas to exceed 25% of the LFL, assuming no ventilation. The potential release quantity is determined by engineering evaluation. The requirements of the Salt Dissolution/Interstitial Liquid Removal Program shall apply in this mode
4. All activities allowed in Operation are permitted.

Item 3 above does not apply to Tank 3 salt removal activities.

To prevent tank explosion scenarios (Ref. 2, Section 3.4.2.11 "Waste Tank Explosion"), controls are placed on operation of waste removal as follow:

Control for waste tank undergoing interstitial liquid removal, (Ref. 2, p. 3.4-139). The salt dissolution/interstitial liquid removal program will control interstitial liquid removal activities to limit planned release of trapped gas such that the vapor space does not exceed 25% of the LFL. No specific controls (other than Routine Ventilation Controls) on interstitial liquid removal activities are required on tanks where an evaluation shows that the release of hydrogen due to interstitial liquid removal will not cause the percent of LFL to exceed 25% (assuming all interstitial liquid in the tank above the pump suction is removed). For tanks where the percent LFL could exceed 25%, waste tank ventilation with flow indication (including control room alarm) and continuous hydrogen monitoring (including control room alarm on high LFL or low sample flow) are required during interstitial liquid removal to ensure that the tank does not go above 25% of LFL during the activity. Interstitial liquid removal will be secured via interlock on low ventilation flow or high LFL indication.

Controls of waste tanks undergoing planned salt dissolution, (Ref. 2, p 3.4-139). The salt dissolution/interstitial liquid removal program will control salt dissolution activities to limit planned release of trapped gas such that the vapor space does not exceed 25% of the LFL. No

specific controls (other than Routine Ventilation Controls) on salt dissolution are required on tanks where an evaluation shows that the release of hydrogen due to salt dissolution will not cause the percent LFL to exceed 25%. The flammable vapor release methodology described in section 3.4.1.5.3 shall be used in determining the quantity of hydrogen released. In determining the amount of hydrogen released, it is assumed that the amount of salt dissolved in the affected tank is equal to the smaller of the total volume of salt in the tank or the volume of the water source which will be used for salt dissolution (assuming the source does not have the capability for continuous makeup). For tanks where the percent LFL could exceed 25%, waste tank ventilation with flow indication (including control room alarm) and continuous hydrogen monitoring (including control room alarm on high LFL or low sample flow) are required during salt dissolution to ensure that tanks do not go above 25% of LFL during the activity. The dissolution liquid source will be secured via interlock on low ventilation flow or high LFL indication.

- Consistency between the accident analysis (accident scenarios) results and the technical bases of the TSR (Reference 2, chapter 5 "Derivation of Technical Safety Requirements.")

Safety/engineering calculation for interstitial liquid removal (Ref. 7), using DSA methodology listed above, indicates Tank 3 would reach 25% LFL if 28.9 inches of interstitial liquid is removed from saltcake. Since the goal for Tank 3 is to remove 179.5 inches of interstitial liquid, Tank 3 requires operation in the Gas Release Mode.

Consistent with interlock and alarm requirements for Gas Release Mode operation above, Design Change Packages (Ref. 9) are being implemented to install the required interlocks and alarm systems. These modifications include interlocks to stop the interstitial liquid supply such that upon low ventilation flow or high LFL conditions, the mechanism (pump stop and/or valve closure on dissolution) for releasing the trapped gas is stopped (pump/valve interlock). The appropriate equipment (safety class ventilation-flow interlock and safety significant hydrogen monitoring interlock) and associated setpoints have been identified in the TSR.

- Review for preservation of safety margins from DSA and TSR bases as listed in LCO and Set Points.

TSR set points (Ref. 8, Attachment 1, p. 3/4.8.9-5 and p. 3/4.8.10-5) are consistent with results from uncertainty calculations (below) and DSA credited/assumed values.

- Review for adequate incorporation of uncertainty analysis.

Instrumentation uncertainty calculation for the ventilation flow (Ref. 5) shows a local differential pressure of equal to or greater than 0.1 inch wc for the interlock to protect a minimum flow of 75 scfm. This is consistent with DSA credited 72 scfm. The 0.1 inch is consistently listed in the TSR setpoint table (Ref. 8, attachment 1, p.3/4.8.9-5).

Uncertainty calculation for the hydrogen monitoring system (Ref. 6) was revised to account for the Tank 3 hydrogen monitor. An LCO value of 15% LFL is used (Ref. 8, Attachment 1, p. 3/4.8.10-5) based on previous calculation for potential organics and total instrument uncertainty (Ref. 8, Attachment 1, p. 3/4 8.10-2). This value was previously evaluated and accepted by DOE as documented in earlier DOE SER Revision 0.

- Review for adequate redundancy of systems assumed in DSA and consistent incorporation in TSR

DSA chapter 4 (Ref. 2) - ventilation low flow interlock is safety class with 2 redundant systems of alarm and pump/valve interlocks where the hydrogen monitor is safety significant with 1 interlock and alarm. This is reflected in the TSR LCOs. Therefore, adequate redundancy of safety system has been applied.

The TSR changes for Tank 3 saltcake draining (interstitial liquid removal) and salt dissolution are deemed acceptable for approval.

3.2 TSR Changes (other than Tank 3) Evaluation:

For the TSR changes other than associated with the Tank 3 interlocks, the changes were editorial/non-technical with no change in technical content of the TSR. For example:

- Deleted specific ventilation and hydrogen monitoring system equipment for Tank 7 in LCOs 3.8.9 and 3.8.10. Since there is no current plan to have Tank 7 operate in Gas Release Mode, there is no need for Tank 7 equipment in these LCOs

- For Tank 41, change the combined required actions for ventilation and alarm systems into two separate sets of action: one for alarm system and one for ventilation system. Tank 41 has already undergone interstitial liquid removal with interlock systems in place. These TSR changes for Tank 41 are consistent with the configuration and equipment already installed.

- Changes for the term "breaker/disconnect" to be used with electrical devices such as Pump/Mixer exclusively, where "trip" is used for both mechanical and electrical.

- Changes made for internal consistency (e.g., consistent use of action verbs, consistent use of equipment titles, consistent use of terms from the DSA, etc.).

4.0 Conditions of Approval:

None

5.0 Conclusion:

DOE review concludes that the appropriate controls have been applied to protect onsite workers, the general public, and the environment. TSR changes for Tank 3 are adequate to allow Tank 3 to be operated in the Gas Release Mode for interstitial liquid removal and salt dissolution as these changes are fully consistent with the derived requirements in the DSA. The other (unrelated to Tank 3) TSR changes were editorial/non-technical and also found acceptable. There were no new accidents identified, no increase in frequency or consequences of any analyzed accidents, and no decrease in safety margin due to the submitted changes. Therefore, the changes submitted via Reference 8 are approved.

6.0 References:

1. "Technical Safety Requirements – SRS, Concentration, Storage, and Transfer Facilities," S-TSR-G-00001, Rev. 4, 05/2003

2. "Documented Safety Analysis – Concentration, Storage, and Transfer Facility," WSRC-SA-2002-00007, Rev. 0, 12/2002

3. "WSRC 11Q Facility Safety Document Manual," Procedure 1.01Generation, Review, and Approval of Safety Documents," Rev. 5, 6/11/03

4. "Tank 3 Salt Preparation and Dissolution Technical Plan – Actinide Removal Program," CBU-SPT-2003-00064, Rev. 1 (DRAFT), provided by Paul Carroll (WSRC Tank 3 Salt Program, Design Authority)

5. S.E. Hartman and J.M. Buice, "Instrumentation Uncertainties Evaluation – Waste Tank Purge Exhaust Flow, Tank 3," J-CLC-F-00317, Rev. 0, 6/6/03

6. J.M. Buice and D.E. Fauerby, "Instrumentation Uncertainties Evaluation – Waste tank LFL monitors (excluding Tanks 7 and 48)," J-CLC-G-00048, Rev. 5, 07/14/03

7. B.A. Davis and K.L. Barbour, "Tank 3 Interstitial Liquid Removal," U-CLC-G-00014, Rev. 0, 6/5/03

8. M. D. Johnson, "Submittal of Tank 3 Safety Bases Revision To DOE For Review and Approval," CBU-LWD-2003-00051, 07/30/2003

9. "Design Change Package Cover Sheet – Design Change Package (DCP) Tank 3 Gas Release Mode Modifications," U-PMT-F-03063 Rev. 1, 7/23/2003 (USQ No. TRC-FTF-2003-00153)

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

SEP 12 2003

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Transmittal of Tank 42 Siphon Event Response Plan, (Letter, Johnson to Hansen, CBU-LWD-2003-00054, 9/12/03)

The Department of Energy approves the Response Plan RP-HTF-2003-002, Unqualified Transfer Line, Revision 0 based on the enclosed Safety Evaluation Report (SER).

The action taken herein is considered to be within the scope of work of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please call me or your staff may call Don Blake at 208-8245.

Sincerely,

Jeffrey M. Allison
Manager

DA-03-007

Enclosure:
SER Revision 0, Supplement 7

cc w/encl:
W. J. Johnson, WSRC, 703-H

cc/ w/o encl:
H. T. Conner, Jr., WSRC, 730-1B
L. J. Hollick, WSRC, 730-1B
W. S. Elkins, WSRC, 730-1B
J. P. Schwenker, WSMS, 703-H

Enclosure: Letter, Allison to Pedde "Transmittal of Tank 42 Siphon Even Response Plan," Dated: _____ _____ _____ _____

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 7

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF RESPONSE PLAN RP-HTF-2003-002
Unqualified Transfer Line

September 2003

Prepared by: _____
Donald J. Blake

Reviewed by: _____
Dave Faubert

Approved by: _____
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 7

1.0 Introduction

On September 10, 2003, an inadvertent waste transfer from Tank 42 was potentially routed into a transfer line (WTS-L-13052) that is currently designated as "out-of-service" due to II/I issues associated with seismic qualification. It is necessary to vent and drain the waste from this transfer line, and thus treat this activity as a waste transfer with the appropriate application of the Technical Safety Requirements (TSR). Compliance with the design feature function of the transfer line (i.e., maintain integrity during and following a seismic event) cannot be achieved during the vent and drain activity. In accordance with TSR section 5.4, WSRC prepared and submitted Response Plan RP-HTF-2003-0002 (Reference 1) to DOE to provide the necessary compensatory measures to minimize the risk associated with use of the transfer line for venting and draining until the transfer line can be restored to compliance with the Documented Safety Analysis (DSA) and TSR requirements.

2.0 Review Process

This SER supplement is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

3.0 Review Criteria

Response Plan RP-HTF-2003-0002 was reviewed to ensure it provided compensatory measures such that the risk of an uncontrolled release due to a seismic event during venting and draining of the transfer line is minimized. Additionally, the bases for these compensatory measures were reviewed to ensure there was adequate justification.

4.0 Evaluation

Response Plan RP-HTF-2003-0002 appropriately identifies the DSA and TSR requirements associated with the transfer line in question. Particularly the TSR Table 6.1.2-1 Design Feature for transfer lines requires core piping integrity for containment during normal operations, and during and following a seismic event. This is a credited function for the following DSA events:

- 3.4.2.6 Transfer Line and Transfer Line Jacket /Encasement Explosion (Safety Significant (SS))
- 3.4.2.8 Transfer Facility Explosions (SS)
- 3.4.2.9 Transfer Error (SS)
- 3.4.2.18 Seismic (Safety Class (SC))

The transfer line (WTS-L-13052) piping has been structurally qualified to withstand a PC-3 seismic event (Calculation T-CLC-H-00187, Rev. 1). However, II/I concerns exist with the adjacent pump structural support steel (Calculation T-CLC-H-00659, Rev. 0).

09/12/2003 16:01 FAX 803 725 1910 DOE MNGR OFFICE 003/004

The required actions in the response plan are as follows:

1. the vent and drain will be treated as a waste transfer (either High-Rem or Low-Rem)
2. one dedicated operator (above the TSR minimum) shall be stationed to shut down the transfer line vent and drain activities
3. the transfer line vent and drain activities shall be shut down immediately if H-Area Pump Tank (HPT) 5 level increases by greater than 1000 gallons

Surveillances of the HPT-5 level are required to be recorded every 10 minutes during the transfer line vent and drain activities. The transfer line volume (from Tank 42 to HPT-5) is approximately 400 gallons. Thus, it would take >400 gallons of increase in HPT-5 to determine if waste is being transferred from Tank 42. Flow rates observed during the inadvertent transfer event on September 10 were on the order of approximately 10 gpm. This monitoring frequency provides sufficient time for the operator to verify the tank level, recognize an abnormal condition, and take action to secure the waste transfer prior to exceeding the 1000 gallons level change in HPT-5.

The associated risk of a seismic initiated release during the vent and drain activities is considered acceptable based on the following:

- Allowing the waste to remain in the unqualified transfer line results in a longer time at risk than proceeding with the venting and draining; the duration of the waste transfer during the venting and draining activities is expected to be on the order of approximately less than 1 hour.
- The surveillances of the HPT-5 level and the dedicated operator will limit the amount of material to be transferred thus limiting the time at risk.
- Treating the venting and draining as a waste transfer results in application of other TSR requirements (e.g., Transfer Control Program, Leak Detection, Transfer Facility Ventilation, etc.).
- The Response Plan expires 30 days from the date of issuance.

5.0 Conditions of Approval

None.

6.0 Conclusions

Based on the evaluation documented in Section 4.0 of this SER supplement, DOE review of Response Plan RP-HTF-2003-002 concludes the appropriate safety basis controls are identified to protect the onsite workers, the general public, and the environment and thus minimize the amount of material and time at risk for the waste transfer. Therefore, the Response Plan submitted in Reference 1 is approved.

7.0 References

1. Letter, Johnson to Hansen, "Transmittal of Tank 42 Siphon Event Response Plan," 9/12/2003, CBU-LWD-2003-00054

09/12/2003 16:01 FAX 803 725 1910 DOE MNGR OFFICE 004/004

OCT 1 7 2003

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Request for Department of Energy (DOE) Approval of Defense Waste Processing Facility (DWPF) Technical Safety Requirements (TSR) Revision 28 and Documented Safety Analysis (DSA) Revision 21

References:
1. Letter, French to Hansen, "Request for DOE Approval of DWPF TSR Revision 28 and DSA Revision 21," CBU-WSD-2003-00037, 09/18/03
2. Letter, Hansen to Johnson, "Submittal of DWPF TSR Revision 28 and DWPF DSA Revision 21 to DOE for Review and Approval," DC-03-014, 08/27/03
3. Letter, French to Hansen, "Submittal of DWPF TSR Revision 28 and DWPF DSA Revision 21 to DOE for Review and Approval," CBU-WSD-2003-00027, 07/28/03
4. Letter, French to Hansen, "Request for DOE Approval of DWPF TSR Revision 28 and DSA Revision 21 Including Resolution of LCS-210," CBU-WSD-2003-00042, 10/14/03

DOE Savannah River Operations Office (SR) has completed its review of Revision 21 to the DWPF DSA, Revision 28 to the DWPF TSR, Change Request HLW-CRF-03011 to the Concentration, Storage, and Transfer Facilities (CSTF) DSA, and Revision 2003-F to the CSTF TSR as submitted in References 1, 3, and 4. The page changes submitted in References 3 and 4 were found to satisfactorily address DOE-SR review comments and questions that were transmitted in Reference 2. Based on the review, DOE-SR approves the submitted changes as safety basis documents. The two enclosed Safety Evaluation Reports (SERs) document the results of the DOE evaluation and provide the basis for approval.

The DWPF SER (Enclosure 1) has been issued as a new revision (Revision 1) and replaces the previous Revision 0 and each of the 33 SER supplements. Relevant portions of SER Revision 0 and each SER supplement were brought forward, as necessary, to document the basis for safe operations of the facility. Any future change requiring SR review and approval will be issued against SER Revision 1 or be issued as a new SER revision.

The CSTF SER, Revision 0, Supplement 8 (Enclosure 2) approves the changes to the CSTF Administrative Control covering facility transfers during high wind conditions.

It is expected that the DSA and TSR revisions will be added to the WSRC-IM-94-10 Manual within the next 21 days. It is mutually recognized that an Authorization Agreement (AA) revision is needed to support implementation of the DSA and TSR revisions. The next AA revision needs to recognize the issuance of DWPF SER Revision 1 and removal of the Justification for Continued Operations.

The action directed herein is considered to be within the scope of work of the existing contract. If the Contractor considers that carrying out this direction will increase contract costs or delay any delivery, the Contractor shall promptly notify me orally, confirming and explaining the notification in writing as soon as possible, but within no more than five (5) working days.

Following oral notification and submission of the written notice of impacts, the Contractor shall await further direction from me.

If you have any questions, please contact me or Jimmy Guerry, of my staff, at 208-1218.

Sincerely,

Original Signed by
Charles E. Anderson

for Jeffrey M. Allison
Manager

WDED:JAG:kl

DC-04-001

2 Enclosures:
1. DWPF Safety Evaluation Report
2. CSTF Safety Evaluation Report

cc w/o encls:
H. T. Conner, Jr., WSRC, 730-1B
W. J. Johnson, WSRC, 730-1B
L. J. Hollick, WSRC, 730-1B
J. C. Devine, WSRC, 703-H
W. S. Elkins, 730-1B
M. D. Miller, WSRC, 704-S
J. W. Ray, WSRC, 704-S

cc w/encls:
J. W. French, WSRC, 704-S
J. L. Barnes, WSRC, 704-S
D. B. Little, WSRC, 703-H

bcc w/encls:
J. Smartt, SRPD, 730-B
R. J. Hardwick (EH-2), HQ
T. C. Temple, WDED

bcc w/o encls:
D. J. Blake, WDED
J. A. Guerry, WDED
WDED Rdg File
AMWDP Rdg File
MGR's Rdg File
MC + DMB Rdg File
ECAT (MC #031523, MC #031244)

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 8

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 0,
Change Request Package HLW-CRF-03011

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2003-F

October 2003

Prepared by : Donald J. Blake
Donald J. Blake

Reviewed by: _____
David R. Faubert

Approved by: _____
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 8

1.0 Introduction

The CSTF Safety Basis (SB) changes submitted via Reference 1 revise the DWPF interface section of the DSA/TSR with respect to administrative controls during transfers from CSTF to DWPF.

The specific safety basis documents submitted for review and approval related to the DWPF DSA/TSR changes are:

- Change Request Package HLW-CRF-03011 to the CSTF DSA, WSRC-SA-2002-00007, Revision 0
- CSTF TSR, S-TSR-G-00001, Revision 2003-F

2.0 Background

Reference 1 submitted DWPF DSA and TSR changes associated with removing precipitate related analysis and controls (i.e., going to sludge-only safety basis) while applying new analysis utilizing updated dose conversion factors. This updated analysis resulted in a revision to the safety basis control set. In the process of revising the controls, a revision to the administrative controls associated with transfers from CSTF to DWPF was determined to be necessary. The CSTF DSA/TSR changes were provided to DOE for approval as an Attachment to the DWPF DSA/TSR change package. The DWPF DSA/TSR changes will be approved via a separate SER.

3.0 Review Process

This SER supplement is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

4.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, the various DSA sections were consistent, and the changes were consistent with the DWPF DSA/TSR requirements for interface with other facilities. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk

was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs provide clear administrative controls and are consistent with the accident descriptions and credited controls.

5.0 Evaluation

DSA Section 5.7.2.1 (Interface With Defense Waste Processing Facility) and TSR Section 5.8.2.47 (Transfers to DWPF and Saltstone) were revised to include a high wind warning/event requiring termination of transfers and establishing a siphon break. This is one of the key elements of the programmatic control to preclude an overflow of the receiving tank or cell at Building 512-S (Actinide Removal Process Facility) or Low Point Pump Pit. For transfers initiated in the Tank Farms, the Transfer Control Program (TSR 5.8.2.21) requires monitoring for transfer events, siphon evaluations, and identification of equipment to stop transfers and siphons, among other requirements, to minimize the consequences associated with a transfer event. In addition, the Severe Weather Response Program (TSR 5.8.2.24) requires securing of transfers upon issuance of a tornado watch/warning or high wind warning. The CSTF administrative controls are more conservative and therefore the proposed change does not impact the CSTF DSA or TSR. For DWPF initiated transfers to the Tank Farms, the volume at risk is limited to the capacity of the sending tank and the receiving vessels are equivalent in capacity. Therefore, overflow due to DWPF initiated transfers is not a concern.

The CSTF and DWPF Interface Administrative Control (CSTF TSR Section 5.8.2.47) is consistent with the DWPF TSR (WSRC-TS-95-0019; S-TSR-S-00001) Administrative Controls 5.8.2.12 (Tornado Warning Response) and 5.8.2.20 (Transfers from H-Area) as well as DWPF DSA (WSRC-SA-6) Chapter 11, Section 11.7.2.2 (Interarea Transfer Accidents) that were submitted to DOE for approval via Reference 1. The DWPF DSA and TSR changes are evaluated and approved in DWPF SER Revision 1.

6.0 Conditions of Approval

None.

7.0 Conclusions

Based on the evaluation documented in Section 5.0 of this SER supplement, DOE review of the SB changes concludes there were no changes to the Design Basis Accidents defined in the DSA and the appropriate interface SB controls have been identified to protect the onsite workers, the general public, and the environment. Therefore, the proposed CSTF DSA/TSR changes submitted in Reference 1 are approved.

8.0 References

1. Letter, French to Hansen, Submittal of DWPF TSR Revision 28 and DWPF DSA Revision 21 to DOE for Review and Approval, CBU-WSD-2003-00027, 7/28/03.

NOV 2 6 2003

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Submittal of Revision 1 of the Concentration, Storage, and Transfer Facilities (CSTF) Documented Safety Analysis (DSA) to DOE for Review and Approval, (Letter, Johnson to Hansen, CBU-LWD-2003-00056, 11/3/03)

The Department of Energy (DOE) has evaluated the subject safety basis document revisions and approves them based on the enclosed Safety Evaluation Report (SER). There are no conditions for approval, but one revision issue documented in the SER. It is expected that the DSA and Technical Safety Requirements revisions will be added to the WSRC-IM-94-10 Manual upon implementation. A revision to the CSTF Authorization Agreement is not required.

The action taken herein is considered to be within the scope of work of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or have your staff contact Don Blake at 208-8245.

Sincerely,

Original Signed By
Jeffrey M. Allison

Jeffrey M. Allison
Manager

WDED:DB:kl

DC-04-09

Enclosure:
SER Revision 0, Supplement 9

cc w/o encl:
W. J. Johnson, WSRC, 730-1B
H. T. Conner, Jr., WSRC, 730-1B
L. J. Hollick, WSRC, 730-1B
W. S. Elkins, WSRC, 730-1B

cc w/encl:
J. C. DeVine, WSRC, 703-H
J. P. Schwenker, WSMS, 703-H
D. B. Little, WSRC, 703-H

bc w/encl:
D. L. Blake, WDED
T. C. Temple, WDED
J. A. Smartt, SRPD, 730-B
R. J. Hardwick (EH-2), HQ
File

bc w/o encl:
WDED Rdg File
AMWDP Rdg File ECAT
MGR Rdg File DMC + DMB Rdg

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 9

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 1,

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2003-G

November 2003

Prepared by : Donald J. Blake
Donald J. Blake

Reviewed by: Thomas C. Temple
Thomas C. Temple

Approved by:
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 9

1.0 Introduction

The CSTF Safety Basis (SB) changes submitted via Reference 1 incorporate the outstanding DSA change packages into DSA Chapters 2 through 6, resolve the Potential Inadequacy to the Safety Analysis (PISA)/Unreviewed Safety Question (USQ) related to hydrogen release due to free supernate removal from salt tanks, and resolve two outstanding DOE SER Revision Issues.

The specific safety basis documents submitted for review and approval are:

- CSTF DSA, WSRC-SA-2002-00007, Revision 1, which incorporates the following:
  - DSA Change Package HLW-CRF-03005, Revision 1 (excluding the Executive Summary and Chapter 15 changes); DOE approved via SER Revision 0, Supplement 1
  - DSA Change Package HLW-CRF-03007; USQS TRC-WPT-2003-00210
  - DSA Change Package HLW-CRF-03008; USQS TRC-HTF-2003-00173
  - DSA Change Package HLW-CRF-03009; DOE approved via SER Revision 0, Supplement 4
  - DSA Change Package HLW-CRF-03010, Revision 1; DOE approved via SER Revision 0, Supplement 4
  - DSA Change Package HLW-CRF-03011; DOE approved via SER Revision 0, Supplement 8
  - PISA/USQ NI-CST-03-001 Resolution
- CSTF TSR, S-TSR-G-00001, Revision 2003-G

In addition, various other changes were included in this DSA/TSR Revision package as summarized below:

- Revised "Removed from Service" definition to lower the allowable dose potential and eliminate prior DOE approval
- Eliminated Component Location Identifiers (CLI) numbers from TSR
- Revised HDB-2 probe setpoint due to slope in floor
- Revised TSR Manning requirements to add Radiological Control personnel and provide flexibility for tanks that can reach LFL in less than 24 hours
- Added option to allow hydrogen monitoring/sampling in lieu of 12 vapor space turnovers
- Recognized that air blowdown of steam jets could be as long as 30 minutes
- Clarified criticality safety basis for Tank 48 and added references to various Nuclear Criticality Safety Evaluations/Assessments
- Clarified design/backfit requirements for passive components within a safety class boundary
- Miscellaneous editorial/administrative corrections

2.0 Review Process

This SER supplement is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement

based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

DOE-SR provided informal comments on the draft documents in parallel with WSRC review. These comments have been resolved and/or incorporated into the documents submitted via Reference 1 for DOE approval. This review ensured that those comments were adequately resolved and the appropriate changes made to the DSA/TSR.

3.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, the various DSA sections were consistent, and the changes were consistent with the interface requirements with other facilities. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs: (1) are clear with respect to process area applicability; (2) provide adequate justification to support Limiting Conditions for Operation (LCO) conditions, actions and surveillance requirements; (3) provide clear administrative controls; and (4) are consistent with the accident descriptions and credited controls.

4.0 Evaluation

4.1 Waste Tank Removed From Service (RFS)

The intent of the RFS Mode is to recognize that once a waste tank has had its waste removed to the point where it is ready for permanent closure (e.g., grouting), specific safety basis controls are no longer required to be applied since the hazard has been removed to the maximum extent practical (typically this results in a remaining heel of < 10's of thousands of gallons). CSTF SER Revision 0, Supplement 1 previously approved the RFS Mode requirements. This DSA Revision 1 modifies the previous definition of the Removed From Service Mode which required DOE approval prior to entering into this Mode and changes the total effective inhalation dose potential to less than or equal to 1.0E+11 rem (from 1.0E+12 rem). The order of magnitude inhalation dose potential change essentially would allow an equivalent of up to 10 waste tanks to be in RFS Mode without an increase in the previously accepted risk. Due to the physical size and configuration of the waste tanks in the tank farms, it is impossible for an individual to be located within 100 meters of 10 or more waste tanks. Therefore this DSA/TSR revision allows WSRC to place tanks into RFS Mode that meet RFS Mode requirements without DOE approval. This will ensure that the tank entering the RFS Mode meets the 1.0E+11 rem limit as well as the other requirements as defined in DSA Section 5.4.3 (Waste Storage Tanks Modes) and TSR Section 1.6 (Modes), and is ready for permanent tank closure (e.g., grouting).

Another change from the previously approved requirements dealt with isolation of motive forces within the waste tank and pressurization sources to the waste tank. Revision 0 required blanks for isolation of air/steam to transfer jets, pressurization sources to pumps/mixers, bearing water supply to pumps, and cooling water supply/return for tank. Revision 1 requires "physical isolation" of these sources, excluding the use of administratively controlled valves. Examples of acceptable methods to isolate these sources would be blanks and cutting/capping.

Isolation of the waste tank from the transfer system (e.g., diversion boxes, valves boxes, transfer lines, etc.) is addressed by requiring specific line segments to be placed Out-of-Service. To be designated Out-of-Service, a transfer line could be isolated using a single tested valve or two untested valves, blanks, cutting/capping, etc. The next tank identified to be placed into RFS Mode is Tank 18F. DOE has evaluated the isolation plans for Tank 18F and found these plans similar to the isolation provisions on Tank 19F, which DOE reviewed and accepted in SER Revision 0, Supplement 3. Thus, DOE concludes that adequate isolation provisions have been made for Tank 18F. No closed valves were used to isolate Tank 18F from the transfer system. However, the RFS Mode definition would allow this method. For future tanks to be placed into the RFS Mode, it is DOE expectation that blanks (or cutting/capping) be the preferred method used for physical isolation of the tank (versus closed valves) from the waste transfer system. Therefore, as a **Revision Issue (CSTF-0-9-R1)** and prior to placing another tank into RFS Mode after Tank 18, the DSA and TSR RFS Mode definition should be revised to reflect the preferred method of tank transfer system isolation being blanks or cutting/capping. The result of this action is that controls directly applicable to Tank 18F and associated equipment will no longer be required for Tank 18F. Therefore, administrative control programs such as Corrosion Controls, Structural Integrity, Sludge Carryover Minimization, Transfers from Waste Tank Annuli, Flammable Vapor Sampling Monitoring, Pump Run, etc. will no longer applicable to Tank 18F. Likewise, equipment and associated TSR Limiting Conditions for Operation for Tank Ventilation, Tank Lower Flammability Limit monitoring, High Liquid Level Conductivity Probe, etc. will no longer be applicable to Tank 18F.

The overall impact to the risk of the worker located at the 100 meter receptor location due to the combined impacts from various scenarios in a seismic event was assessed with the potential for 10 waste tanks in the RFS Mode. The seismic scenarios resulting in the largest onsite consequences (excluding waste tank and pump tank explosions) were evaluated in Reference 2. The evaluation concluded the risk to the onsite worker is considered to be significantly less than that documented in the DSA. This conclusion is based on the following:

- Conservative assumptions in the analysis
  - concrete evaporator cell/pump pit structure (with 3 ft thick walls and 2 ft thick roof) fails, resulting in no reduction in source term
  - pump tank is operating at overflow level at time of seismic event (typically operate at 3/4 fill level; thus not all of 15K gal of waste is spilled into pit)
- Low probability that an individual is downwind and within 100 meters of an overpressurizing evaporator, an overflowing pump tank (with sludge slurry), and ten collapsing tank tops from RFS Mode tanks (at maximum permitted inhalation dose potential).

- Low probability that an individual would remain within 100 meters for the entire exposure duration assumed in the analysis (minimum of 2 hours).

DOE agrees with the conclusion that the proposed revision does not impact the risk to the onsite worker.

4.2 CLI Number Deletion from TSR

The TSR document currently provides a Component Location Identifier (CLI) Number within several Limiting Conditions for Operations (LCO's) for those safety related components credited with preventing/mitigating a particular accident. The CLI number is unique to a component such that the same component on a different tank would have a different CLI number. If a tank requires a certain component (e.g., high hydrogen interlock to shutdown slurry pump) to be operable prior to entering a particular mode (e.g., Gas Release Mode), the component would need to be specifically identified in the TSR (by CLI number). This would require a TSR change if the tank was not previously equipped with this component. This proposed TSR Revision eliminates the CLI numbers from the TSR and just refers to the component by name. Thus, provided the component's uncertainty value is consistent with the calculated uncertainty referenced in the TSR document, a TSR change would not be required for implementation on a particular tank. DOE agrees the component nomenclature description is adequate and the change will minimize the number of unnecessary TSR changes in the future.

4.3 HDB-2 Probe Setpoint

TSR Table 3.7.2-1 of LCO 3.7.2 (Diversion Box Sump Level) was revised to change the HDB-2 conductivity probe height setpoint to ≤ 5 inches from cell floor. The previous value of ≤ 0.5 inches assumed a level cell floor. It was determined the HDB-2 cell floor had a slope to the location of the conductivity probe. DOE has confirmed through review of Drawings W702648, Revision 17, W163323, Revision 23, and W163187, Revision 49 that there is a slope of 3/8 inch/ft towards the sump location. The setpoint of 0.5 inches was equivalent to a much smaller waste volume than the DSA assumed residual value of 1.29% of the total cell volume (3763 ft^3). Calculation J-CLC-H-00818 determined the HDB-2 conductivity probe height which correlates to the residual cell volume (48.5 ft^3) to be 5.9 inches. Accounting for uncertainty, a TSR value of ≤ 5 inches has been established in Table 3.7.2-1 for HDB-2. Reference 3 documents the residual levels to be used in the DSA. DOE review of the supporting documents and drawings concludes an appropriate setpoint has been provided for HDB-2.

4.4 TSR Manning Requirements

TSR Administrative Control Section 5.2.2 (Facility Staff) was revised to allow for manning flexibility in response to a seismic event for waste tanks that could become flammable in less than 24 hours. The Flammability Control Program (TSR Section 5.8.2.27) allows a maximum of 7 waste tanks that can reach 100% LFL in less than 24 hours, assuming no ventilation and including the effects of post seismic trapped gas release. There is no restriction on the location of these tanks (F-Area Tank Farm or H-Area Tank Farm). Therefore, the required number of operators has been associated with the number of simultaneous Operational Conditions for the Tank Farm Area. A tank that can reach 100% LFL in less than 24 hours post seismic has been designated as an Operating Condition. Other Operating Conditions include: waste transfers, evaporator operation,

tank mixing, salt dissolution, and inerted operation of Tank 48. Additionally, in response to a DOE comment during review of DSA Revision 0 and TSR Revision 0, radiological control personnel have been included in the minimum shift crew composition to respond to spills/releases and recommend necessary actions to protect personnel. Reference 4 documents the basis for the manning requirements. DSA Section 5.5.5 was appropriately revised to provide the technical bases for the requirements. DOE review concludes the manning requirements are adequately defined to place the facility in a safe condition and complete necessary routine surveillances and manual actions assumed by the safety analysis (e.g., shutdown processes/transfers).

4.5 12 Vapor Space Turnovers

DSA Section 3.4.2.11 (Waste Tank Explosion) addresses hydrogen plumes resulting from significant trapped gas releases (e.g., mixing operations, salt dissolution). Hydrogen plumes are considered an acceptable risk provided the calculated hydrogen release does not result in the entire vapor space hydrogen concentration exceeding 25% LFL. A critical assumption is that the initial hydrogen concentration in the tank vapor space is as low as practical. The DSA Revision 0 validates this by requiring a minimum of 12 vapor space volume changes prior to initiating the activity that will release trapped gas. The proposed DSA Revision 1 adds an option to verify the reading from the LFL monitor is less than the initial value assumed in the hydrogen release engineering evaluation. If this option is used, the methodology used to determine the flammable vapor concentration is to be consistent with the requirements outlined in Reference 5. This means the LFL analyzer must be calibrated with a standard that is equivalent to the assumed initial hydrogen concentration. DOE review of this methodology found it to be at least equivalent to the 12 vapor space turnover requirement and therefore an acceptable option.

4.6 Air Blowdown of Steam Jets

DSA Section 5.5.2.1 (Waste Tank Purge Ventilation – Operation - LCO 3.8.1) was revised to recognize that the nominal range for a normal air blow following steam transfer jet operation is 5 to 30 minutes to prevent suckback and/or siphons. A time for the air blow was not previously stated. However, it was generally accepted that for most jets the air blow was 5 minutes, with a few ranging up to 15 minutes. It is stated that this air blow does not have a significant impact on the aerosolization accident progression. The unmitigated accident progression for a waste tank aerosolization due to steam jet failure in DSA Section 3.4.2.10 (Aerosolization Events) assumes steam/air is isolated to the jet in 2 hours (both seismic and non-seismic). This event is prevented by transfer jet and piping integrity and the Transfer Control Program (discharge valve position verification and evaluation of core pipe pluggage). DOE agrees that the air blow is necessary and has a negligible impact on the analyzed accidents.

4.7 Criticality

DOE SER Revision 0, Supplement 1 (Reference 6) identified a Revision Issue (CSTF-0-1-R1) to revise DSA Section 6.4.1 to reflect the accurate mass of monosodium titanate (MST) in Tank 48 and the basis for criticality safety consistent with the approach in SRT-LWP-2002-00112.

This DSA Chapter 6 Revision 1 now describes Tank 48 as being different from other high level waste tanks due to the presence of MST and tetraphenylborate (TPB). MST was added to the tank to remove strontium, uranium, and plutonium. The resulting solids settled to the bottom of the tank

(with uranium and plutonium). A Nuclear Criticality Safety Assessment (NCSA) for Tank 48 (WSRC-TR-2003-00169) has been completed and referenced in DSA Section 6.3.1. The NCSA consolidates and references the previous Tank 48 Nuclear Criticality Safety Evaluations (NCSEs) that determined, based on the ratio of MST to fissionable material, the adsorption capability of fissile material on the MST, and sample results, there are no criticality concerns with Tank 48. The NCSA concludes the NCSEs are still applicable to the material currently in Tank 48. DOE agrees with the inclusion of the Tank 48 NCSA in Chapter 6 and considers Revision Issue CSTF-0-1-R1 closed.

DOE SER Revision 0, Supplement 4 (Reference 7) identified a Revision Issue (CSTF-0-4-R1) concerning the technical basis for asserting a bounding tank farm uranium enrichment value of 66%. A technical report (CBU-LTS-2003-00033, Rev. 0, "Bounding Enrichment in H-Area Salt Tanks") has been completed and referenced in DSA Section 6.3.1 to provide this technical basis. The DSA Revision 1 states that because the F-Area tanks contain only PUREX (principally depleted uranium), the bounding value would apply to F-Area tanks as well. DOE has reviewed the referenced report and agrees with the DSA conclusion. DOE Revision Issue CSTF-0-4-R1 is considered closed.

4.8 Passive Safety Class (SC) Component Design Requirements

DSA Section 4.3 (SC Structures, Systems, and Components) was revised to add a clarification regarding design/backfit requirements for passive components. The clarification states that passive SC components are not required to be redundant if they satisfy the other applicable design requirements (i.e., resistance to earthquakes, tornados, flood, explosion, and fire; environmental considerations; electrical/mechanical requirements; quality assurance; maintenance; testing; functionality). DOE review of IEEE Standard 379-2000 (referenced in DOE G 420.1-1) with respect to single failure criterion for safety systems concluded that the clarification is consistent with the industry standards for safety systems. A specific application where this clarification is needed is in DSA Chapter 4, Sections 4.3.13 (Waste Tank Ventilation Low Flow Interlock and Alarm). A single, passive SC flow element is installed in the ventilation flow path and feeds two independent flow indicating transmitters, interlocks, and alarms. This is considered an acceptable configuration for a SC system. The system description for this system (DSA Section 4.3.13.2) was revised to clarify the nomenclature of the required redundant components in the system.

4.9 Miscellaneous Editorial/Administrative Changes

The more significant changes in this category are summarized below:

- DSA Section 3.4.1.5.2 and TSR Administrative Control 5.8.2.43.a were clarified stating transfers out of inactive locations are permitted. Waste transfers out of these locations are acceptable since it will not introduce any additional waste and therefore, no additional risk.
- In DSA section 3.4.2.11 (Waste Tank Explosion), it has been clarified that although experience has shown that 4 slurry pumps are adequate to ensure sufficient mixing to release the trapped gas inventory, it is acceptable to evaluate empirical gas release data for a given tank and demonstrate adequate mixing (and depletion of trapped gas inventory) could occur with less than 4 slurry pumps. A baseline with 4 slurry pumps would be required for that tank to perform the evaluation. This evaluation was satisfactorily demonstrated for Tank

40H. DOE has reviewed this approach and agrees that a defendable technical basis could be developed with an adequate evaluation.

- TSR LCOs (and Bases) 3.8.1 (Waste Tank Purge Ventilation System- Operation), 3.8.8 (Tank 8, 40, 42, and 51 Purge Ventilation System – Gas Release), and 3.8.9 (Waste Tank Purge Ventilation System – Gas Release) Action Statements were revised to include isolation of air to transfer jets in addition to isolation of steam to preclude an aerosolization event. DOE agrees that the isolation of steam and air is appropriate.
- TSR Administrative Control 5.8.2.7 (Installed Process Instrumentation (IPI), Measuring and Testing Equipment (M&TE), and Other TSR Measuring Devices) was revised to address equipment that is not part of the IPI or M&TE programs (e.g., video camera used for level indication or leak detection). The control requires this type of equipment to be within applicable calibration and preventive maintenance frequencies when used to comply with TSR requirements. DOE agrees with the alternative requirements for this type of equipment.
- DSA Sections 3.4.2.7 (Transfer Facility Explosions), 3.4.2.9 (Transfer Error), 3.4.2.18 (Seismic), and 4.4.33 (H-Area Catch Tank and Catch Tank Encasement) were revised to clarify whether the Catch Tank or Catch Tank Encasement was being credited for mitigation of the event. Both provide passive containment during normal operations, and during and following a seismic event. The Encasement structural integrity is also required for a seismic event to ensure Catch Tank integrity (II/I). DOE agrees with the clarification of the functional requirements.
- TSR LCO 3.7.6 (HDB-8 Complex Process Vessel Ventilation System) Required Actions B.5.1 and B.5.2 were revised to include a recurring completion time of 24 hours for ensuring forced ventilation on the affected pump tank or hydrogen concentration of less than or equal to 15% LFL. Jet transfer receipts are immediately stopped by Required Action B.2 and therefore, based on Table 3.7.6-2, the recovery time of 24 hours is considered sufficient for a full pump tank volume.
- TSR LCO 3.8.8 (Tank 8, 40, 42, and 51 Purge Ventilation System – Gas Release) Required Action A.4.2 recurring completion time of 12 hours for verifying hydrogen concentration less than or equal to 15% LFL in the affected tank was revised to 24 hours. At least 7 days to reach LFL upon loss of ventilation is maintained for Rapid Generation Tanks. Therefore, a recurring time of 24 hours is considered adequate for the hydrogen concentration verification.

The remaining changes included in this revision were administrative/editorial in nature and therefore do not warrant further discussion. The DOE review concluded these changes did not alter the analysis, controls, or technical bases or the intent of such.

4.10 Incorporation of Existing Change Packages

The specific safety basis changes previously approved by DOE or not requiring DOE approval that have been incorporated into this DSA Revision 1 are identified in Section 1.0 of this SER. DOE review of the safety basis documents ensured that the changes were incorporated consistent with the approved change packages and that the basis for approval was still applicable and relevant.

4.11 PISA/USQ Resolution

Calculation U-CLC-G-00018 was developed to support a DSA improvement initiative relative to salt removal from waste tanks. This calculation concluded that bounding free supernate removal from salt tanks could potentially release more than 59 gallons of hydrogen per inch of level change. This is inconsistent with the current DSA Section 3.4.2.11 (Waste Tank Explosion) assumption that a release of 59 gallons of hydrogen per inch of level change was representative of all salt tanks and that the time to reach LFL increases as free supernate is removed. Reference 8 transmitted to DOE a PISA (NI-CST-03-001) and associated Discovery USQ. Compensatory measures were implemented to prohibit free supernate removal from Tanks 44F and 45F, since the hydrogen released to the vapor space in these tanks would be sufficient to challenge the hydrogen LFL, as shown in Calculation U-CLC-G-00018. Free supernate removal from other waste tanks would be evaluated utilizing the methodology identified in Calculation U-CLC-G-00018.

Calculation U-CLC-G-00019 was completed to support the proposed DSA/TSR changes and determined the bounding hydrogen release rates for Type I/II/III/IIIA salt tanks (which bound sludge values) and Type IV sludge tanks (no salt in Type IV tanks). Calculation S-CLC-G-00303 then determined the minimum ventilation flow rates necessary during free supernate removal to maintain the minimum time to 100% LFL for a given tank hydrogen generation rate category (7 days for Rapid Tanks and 28 days for Slow Tanks). The current ventilation system controls of a minimum 72 scfm ventilation flow rate for Rapid Tanks and 45 scfm for Slow Tanks were demonstrated to be sufficient to maintain the minimum time to 100% LFL, with the exception of Type III/IIIA tanks with large volumes of salt or sludge. Very Slow Tanks by definition, would never reach 100% LFL, accounting for normal tank breathing. However, Calculation U-CLC-G-00019 determined that hydrogen release rates during free supernate removal could potentially cause the vapor space in Very Slow Tanks to reach 100% LFL. Therefore, restrictions have been added to DSA Section 3.4.2.11 to prohibit free supernate removal with specific salt/sludge volumes. The restrictions have been summarized in the Table below.

Tank Design	**H2 Generation Rate Category**	**Salt Equivalent Volume (inches)**	**Sludge Equivalent Volume (inches)**	**Free Supernate Removal Allowed (Yes/No)**
Type I/II/IV	*Rapid*	No limit	No limit	Yes
	Slow	No limit	No limit	Yes
	Very Slow	> 150	> 80	No
Type III/IIIA	*Rapid*	No limit	No limit	Yes
	Slow	> 330	> 250	No
	Very Slow	> 150	> 80	No

The values listed in the Table above include a minimum margin of 10 inches to account for uncertainty in salt/sludge levels and measurements. This margin is judged to be sufficient based on historical level readings. During free supernate removal, the established ventilation flow rates (72 scfm for Rapid Tanks and 45 scfm for Slow Tanks) may not prevent the vapor space previously occupied by supernate from momentarily exceeding 25% LFL. However, it is expected that the hydrogen would quickly dissipate and mix with the bulk vapor space. Periodic hydrogen monitoring is still required as a second level of control for Rapid and Slow Tanks to validate the

effectiveness of the ventilation system. Therefore, the established controls, with the restrictions listed above, are considered acceptable to prevent a waste tank explosion during free supernate removal.

The calculations noted above (U-CLC-G-00019 and S-CLC-G-00303) were reviewed to ensure the inputs and assumptions used were consistent with the facility configuration and existing DSA accident analysis. The calculations utilized appropriate inputs and assumptions that were consistent with the current DSA and facility configuration. For example:

- tank fill factors (2710 gal/in for Type I; 3500 gal/in for Type II; 3510 gal/in for Type III/IIIA; and 3540 gal/in for Type IV) are consistent with DSA Table 3.4-2
- gas fractions for salt (11%) and sludge (10% for tanks not under quiescent time program) are consistent with DSA Section 3.4.1.5.3 (Flammable Vapor Release Methodology)
- bounding hydrogen generation rates for supernate (9.6E-6 ft^3/gal-hr) are consistent with DSA Section 3.4.1.5.5 (Flammable Vapor Release Inputs and Assumptions)

Calculation U-CLC-G-00019 also compared the estimated maximum hydrogen concentration during removal of 50 inches of free supernate from Tank 37 (March 2002) to actual measured concentrations using the same methodology. The difference was within 1% LFL (3% estimated versus 4% measured).

These same restrictions were appropriately and consistently added to DSA Chapter 5, Section 5.5.4.2.43 (Prohibited Activities) and the TSR Administrative Control Section 5.8.2.43 (Prohibited Operations). TSR LCO 3.8.2 (Hydrogen Monitoring – Rapid Generation Tanks - Operation) and LCO 3.8.3 (Hydrogen Monitoring – Slow Generation Tanks - Operation) Required Actions were revised to immediately stop waste transfers into and out of (in lieu of just into) the affected tank if the hydrogen concentration exceeds 15% (25% minus instrument uncertainty). This is necessary to prevent additional release of hydrogen due to loss of head pressure when removing free supernate.

DOE agrees with the resolution of the PISA/USQ and the associated restrictions placed on free supernate removal in the proposed changes.

5.0 Conditions of Approval

None.

6.0 Conclusions

Based on the evaluation documented in Section 4.0 of this SER supplement, DOE review of the SB changes concludes the hazards associated with the Design Basis Accidents have been identified and the appropriate SB controls applied to protect the onsite workers, the general public, and the environment. The SB changes do not result in a change to the previously accepted risk for the CST Facilities. Therefore, the proposed CSTF DSA/TSR changes submitted in Reference 1 are approved.

7.0 References

1. Letter, Johnson to Hansen, "Submittal of Revision 1of the Concentration, Storage, and Transfer Facilities (CSTF) Documented Safety Analysis (DSA) to DOE for Review and Approval," CBU-LWD-2003-00056, 11/03/03.
2. Memo, Cope to Schwenker, "Assessment of Post-Seismic Risk to the Onsite Evaluation Point for CSTF," WSMS-LIC-M-0023, 9/22/03
3. Memo, Arthur and Pelicone to Ortner, "Process Area Residual Levels for the 10CFR830 DSA," HLW-STE-2002-00183, Rev. 3, 4/24/03.
4. Memo, "CST 830 SAR Minimum Shift Crew Composition for the Tank Farms," HLW-CST-02-002, Rev. 4, 10/30/03.
5. Memo, Fauerby to Eide, "Method to Use LFL Monitor to Verify Measured LFL Less Than Specific Value," WSMS-SAE-03-0123, 7/21/03.
6. Letter, Allison to Pedde, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 1," PC-03-018, 3/14/03.
7. Letter, Allison to Pedde, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 4 – Submittal of Tank 41 to Tank 50 Safety Basis Revisions to DOE for Review and Approval," PA-03-0004, 5/27/03.
8. Letter, Johnson to Hansen, "Submittal of Hydrogen Release Due to Supernate Removal From Salt Tanks Potential Inadequacy in Safety Analysis (PISA) and Associated Discovery USQ to DOE for Approval," CBU-LWD-2003-00055, 9/24/03.

8.0 Contributing Reviewers

Roberto Gonzalez	WDED
Terry Montgomery	WDED

MAR 0 5 2004

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Submittal of the 2003 Concentration, Storage, and Transfer Facilities (CSTF) Annual Update, Unreviewed Safety Question (USQ) Annual Report, and Hydrogen Retention in Sludge Tanks Documented Safety Analysis (DSA) Revision

References:
1. Letter, Johnson to Hansen, "Submittal of the 2003 Concentration, Storage, and Transfer Facilities (CSTF) Annual Update and Unreviewed Safety Question (USQ) Annual Report," CBU-LWD-2003-00066, 12/17/03
2. Letter, Olson to Hansen, "Submittal of the Hydrogen Retention in Sludge Tanks Documented Safety Analysis (DSA) Revision (U)," CBU-LWD-2004-00026, 2/11/04

The Department of Energy has evaluated the subject safety basis document revisions submitted via References 1 and 2 and approves them based on the enclosed Safety Evaluation Report (SER). There are no conditions for approval. It is recognized that DSA Revision 2 has already been implemented. It is expected that the DSA change in Reference 2 will be added to the WSRC-IM-94-10 Manual upon implementation. A revision to the CSTF Authorization Agreement is not required.

The action taken herein is considered to be within the scope of work of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days. Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or have your staff contact Don Blake at 208-8245.

Sincerely,

Original Signed by
Charles E. Anderson

for Jeffrey M. Allison
Manager

WDED:DB:kl

DC-04-022

Enclosure:
SER Revision 0, Supplement 10

cc w/o encl:
W. J. Johnson, WSRC, 730-1B
H. T. Conner, Jr., WSRC, 730-1B
J. C. DeVine, WSRC, 703-H
W. S. Elkins, WSRC, 730-1B
W. S. Shingler, WSRC, 730-1B

MAR 0 5 2004

Mr. R. A. Pedde

cc w/encl:
D. B. Little, WSRC, 703-H
J. P. Schwenker, WSMS, 703-H

bc w/o encl:
D. J. Blake, WDED
T. C. Temple, WDED
J. A. Smartt, SRPD, 730-B
R. J. Hardwick (EH-2), HQ
WDED Rdg File
AMWDP Rdg File
MGR Rdg File
DMC + DMB Rdg File
ECAT #031985 and #040221

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 10

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 2
HLW-CRF-04002, Revision 0

March 2004

Prepared by: Donald J. Blake
Donald J. Blake

Reviewed by: Thomas C. Temple
Thomas C. Temple

Approved by: Phillip R Washer
FOR Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 10

1.0 Introduction

The CSTF Safety Basis (SB) changes submitted via Reference 1 incorporate the outstanding DSA change packages into the DSA Executive Summary and Chapters 1 and 7 through 17. This DSA Revision (Revision 2), the Unreviewed Safety Question (USQ) Review Report attached to Reference 1, and the DSA Revision for Chapters 2 through 6 (approved via SER Revision 0 Supplement 9) satisfies the annual update requirements of 10CFR830. The SB change request submitted via Reference 2 incorporates the compensatory measures established in Potential Inadequacy in Safety Analysis (PISA #PI-04-003) as DSA assumptions/controls. This PISA and subsequent USQ document non-conservative DSA assumptions regarding the amount of hydrogen retained in waste tanks with slurried sludge.

The specific safety basis documents submitted for review and approval are:

- CSTF DSA, WSRC-SA-2002-00007, Revision 2
- DSA Change Request HLW-CRF-04002, Revision 0

2.0 Review Process

This SER supplement is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

3.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, the various DSA sections were consistent, and the changes were consistent with the interface requirements with other facilities. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

4.0 Evaluation

4.1 *Annual Update*

Revision 2 to the CSTF DSA incorporated the outstanding changes (as well as additional administrative/editorial changes) associated with the DSA Executive Summary and Chapters 1, 7 through 17 to satisfy the 10CFR830 annual update requirement. DSA Chapters 2 through 6 and the

TSR were previously updated and approved by DOE via SER Supplement 9 (Reference 3). DSA Chapter 18 (Tank 48 Accident Analysis) was reviewed and determined no changes were required. The changes incorporated into DSA Revision 2 were determined by WSRC to not involve unreviewed safety questions and therefore did not require DOE approval for implementation. However, 10CFR830 requires DOE approval of DSA annual updates. DOE evaluation of these changes concludes the WSRC determination was adequate and the changes are acceptable. Examples of the types of changes made are provided below.

- Update organizational changes (e.g., titles, responsibilities, etc.)
- Clarify Natural Phenomena Spectra
- Reference updates
- Miscellaneous editorial corrections

4.2 *USQE Review*

Attachment 1 to Reference 1 provides a list of USQ Evaluations that were completed from November 2002 through October 2003. These evaluations were reviewed to ensure the proposed activity was appropriately evaluated against the DSA assumptions and requirements and the appropriate conclusion reached. A sampling of the evaluations listed in this attachment was reviewed by DOE and found to provide adequate justification and appropriate conclusions that the activity did not involve an unreviewed safety question. Three of the non-USQ Evaluations resulted in DSA Chapter 2 changes that were incorporated into DSA Revision 1 (approved by DOE via Reference 3). Two of the USQ Evaluations listed did result in a USQ. USQ-WPT-2003-00035 (Evaluation of Solids in Tank 50) resulted in a Justification for Interim Operations (JCO) (WSRC-TR-2003-00083) to restrict the material transfers into Tank 50, isolate the Tank from the rest of the Tank Farm, and calibrate the hydrogen monitor to account for benzene. DOE approved the JCO via SER Supplement 1 (Reference 4). USQ-FTF-2003-00382 (DSA Impact of Free Supernate Removal Greater Than 59 gallons of Hydrogen Per Inch Level Change) resulted in a DSA change restricting free supernate removal with specific salt/sludge volumes. DOE reviewed and approved this DSA change in SER Supplement 9 (Reference 3). The non-USQ evaluations reviewed for this SER supplement are listed below.

- TRC-HTF-2003-00136 (Categorical Exclusion for Periodic Operational Impacts From Corrosion Control and Sludge Carryover Minimization Program)
- TRC-WPT-2003-00599 (242-16H Evaporator Lift Control valve Replacement)

Other evaluations (e.g., TRC-WPT-2002-00024, "Tank 40 New Information"; TRC-WPT-2003-00023, "Tank 50 Slurry Pump Installation in Risers B2 and B4"; USQ-WPT-2003-00019, "Lancing Solids Mound in Tank 50 to Support Installation of Tank 50 Riser B2 Slurry Pump") were evaluated at the time of the activity.

4.3 *Incorporation of Hydrogen Retention in Sludge tanks PISA Compensatory Measures*

DSA Section 3.4.1.5.3 (Flammable Vapor Release Methodology) currently states that the percentage of hydrogen generated that is retained is 50%. In addition, it also states that the top 40 inches of sludge may be excluded when determining trapped hydrogen releases from waste tank slurried sludge. Recent data from Tanks 40 and 51 (sludge batch washing) and information

obtained from Hanford indicate these two assumptions may not be conservative. Based on a review of the data, it was determined that the amount of hydrogen retained within slurried sludge corresponded to the slurried sludge depth (i.e., the greater the depth, the more retained) and that hydrogen is retained within the top 40 inches of slurried sludge. A WSRC Technical Report, WSRC-TR-2004-00077, Rev. 0, analyzed the data and confirmed that no hydrogen retention rates exceeded 50% at slurried sludge depths less than or equal to 90 inches. Thus, for sludge volumes up to 90 inches, the current DSA assumption of 50% retention is conservative. For sludge volumes greater than 90 inches, the current DSA assumption is non-conservative. A PISA (PI-04-003) and subsequent Discovery USQ (U-USQ-G-00056) were issued to document the non-conservative assumptions. The compensatory measures from PISA PI-04-003, Rev. 1 have been incorporated into the DSA via Change Request HLW-CRF-04002 as follows:

- DSA Section 3.4.1.5.3 revised to state: "The percentage of hydrogen generated that is retained is 50% for sludge volumes less than or equal to 90 inches and 100% for greater sludge volumes, ..." to incorporate PISA Compensatory Measure #2.
- DSA Section 3.4.1.5.3 revised to delete assumption that the top 40 inches of sludge may be excluded when determining trapped hydrogen releases from waste tank slurried sludge to incorporate PISA Compensatory Measure #1.

The WSRC Technical Report is referenced in the DSA change as a supporting basis for these values. DOE has reviewed the subject report and concludes the revised DSA assumptions are conservative.

5.0 Conditions of Approval

None.

6.0 Conclusions

Based on the evaluation documented in Section 4.0 of this SER supplement, DOE review of the SB changes concludes no new hazards were introduced and the appropriate SB controls have been applied to protect the onsite workers, the general public, and the environment. The SB changes do not result in a change to the previously accepted risk for the CST Facilities. Therefore, the proposed CSTF DSA changes submitted in References 1 and 2 are approved.

7.0 References

1. Letter, Johnson to Hansen, "Submittal of the 2003 Concentration, Storage, and Transfer Facilities (CSTF) Annual Update and Unreviewed Safety Question (USQ) Annual Report," CBU-LWD-2003-00066, 12/17/03.
2. Letter, Olson to Hansen, "Submittal of the Hydrogen Retention in Sludge Tanks Documented Safety Analysis (DSA) Revision (U)," CBU-LWD-2004-00026, 2/11/04.
3. Letter, Allison to Pedde, "Submittal of Revision 1 of the Concentration, Storage, and Transfer Facilities (CSTF) Documented Safety Analysis (DSA) to DOE for Review and Approval," DC-04-09, 11/26/03
4. Letter, Allison to Pedde, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Revision 0, Supplement 1," PC-03-018, 3/14/03

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

JUN 0 4 2004

Mr. Robert A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Submittal of the Tank 48 CLFL Analyzer Potential Inadequacy in Safety Analysis and Associated Response Plan (Letter, Olson to Hansen, 06/04/04)

The referenced letter requested the Department of Energy Savannah River Operations Office (DOE-SR) approval of the Concentration, Storage, and Transfer Facilities (CSTF) Response Plan RP-HTF-04-001, Revision 0. DOE-SR has reviewed the submitted Response Plan and approves this new safety basis document. The enclosed CSTF Safety Evaluation Report (SER), Revision 0, Supplement 11, documents the basis for approval. Additionally, as concluded in the referenced letter, the CSTF Authorization Agreement does not require revision.

You are requested to take action to incorporate the Response Plan into the Liquid Waste Disposition/Waste Solidification Safety Basis Document List (WSRC-IM-94-10) upon implementation of the changes by June 6, 2004. This action has been discussed with David Little of your staff.

The action directed herein is considered to be within the scope of work of the existing contract. If the Contractor considers that carrying out this direction will increase contract costs or delay any delivery, the Contractor shall promptly notify me orally, confirming and explaining the notification in writing as soon as possible, but within no more than five (5) working days. Following oral notification and submission of the written notice of impacts, the Contractor shall await further direction from me.

If you have any questions, please contact me or have your staff contact Tom Temple at 208-8772.

Sincerely,

Jeffrey M. Allison
Manager

DC-04-037

Enclosure:
CSTF SER Rev. 0, Supplement 11

cc w/o encl:
W. J. Johnson, WSRC, 730-1B
H. T. Conner, Jr., WSRC, 730-1B
J. C. DeVine, WSRC, 766-H
W. S. Elkins, WSRC, 730-1B
W. S. Shingler, WSRC, 730-1B

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 11

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF RESPONSE PLAN RP-HTF-04-001
CLFL Analyzer Inoperable on Tank 48

June 2004

Prepared by: Thomas C Temple
Thomas C. Temple

Reviewed by: T C Temple for JLH per telecon
Jerry L. Houghton

Approved by: _____
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 11

1.0 Introduction

On May 30, 2004, the Tank 48H Composite Lower Flammability Limit (CLFL) analyzer was declared inoperable due to excessive drift in the instrument and subsequent inability to re-calibrate within required specifications (see Occurrence Report SR-WSRC-HTANK-2004-0020). This necessitated entering CSTF Technical Safety Requirements (TSRs) Limiting Condition for Operation (LCO) 3.3.1, Condition B, which requires, in part, restoration of the CLFL analyzer within 7 days (i.e., by June 6, 2004). On June 3, 2004, while the Tank 48H CLFL analyzer was still inoperable, WSRC and DOE met to discuss new information from the CLFL analyzer vendor concerning appropriate correction factors (to account for differences between the calibration gas (hydrogen) and the gas of concern (benzene)) as well as the proper treatment of gain (electronic adjustment) when the sampled calibration gas is diluted with an equal amount of air (only required on Tank 48H due to benzene and the potential to operate under inerted (nitrogen) conditions). Based on this meeting, a Potential Inadequacy in the Safety Analysis (PISA) was conservatively declared (PI-04-004) regarding the Tank 48H CLFL analyzer and this analyzer declared (in this case, maintained) inoperable until PISA resolution. Since confirmation of validity of and proper incorporation of the impact from the new vendor information, as well as effectiveness of changes implemented to address previous calibration problems (Reference Occurrence Reports SR-HTANK-2004-0018, -0019, and -0020), is expected to go past June 6, in accordance with TSR sections 3.0.3 and 5.4, WSRC prepared and submitted Response Plan RP-HTF-04-001 (Reference 1) to DOE to provide the necessary compensatory measures and justification to maintain Tank 48H in a safe condition until the Tank 48H CLFL analyzer can be restored to compliance with DSA and TSR requirements.

2.0 Review Process

This SER supplement (Supplement 11) is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

3.0 Review Criteria

Response Plan RP-HTF-04-001 was reviewed to ensure it provided compensatory measures such that the risk of storing waste in Tank 48H was equivalent to the risk utilizing the DSA and TSR controls. Additionally, the bases for these compensatory measures were reviewed to ensure there was adequate justification.

4.0 Evaluation

The current CSTF TSRs, LCO 3.3.1, require the Tank 48H CLFL analyzer alarm to be set $\leq$ 20% CLFL in order to protect the CSTF Documented Safety Analysis (DSA) safety analysis value of 37% CLFL. Additionally, LCO 3.3.1 requires, if the CLFL analyzer becomes inoperable, to:

a. terminate all liquid additions (some exceptions allowed per TSR Administrative Control 5.8.2.48.c), <u>and</u>
b. stop all slurry pumps, <u>and either</u>

c.1 restore the CLFL analyzer to operable status within 12 hours, or

c.2.1 increase frequency of verification of vapor space concentration being ≤ 20% CLFL using alternate device to every 8 hours (versus every 12 hours), and

c.2.2 restore the CLFL to operable status within 7 days

In essence, LCO 3.3.1 requires Tank 48H to be put in a state where no increase in benzene release rate should occur and allows an alternate vapor space monitoring instrument to be used every 8 hours for up to 7 days. The Bases given in the TSRs for the 7 days states this "adds little risk since an alternate source of CLFL monitoring is in place." The CSTF DSA and TSRs already prohibit any waste transfers into or out of Tank 48H. With Tank 48H in a quiescent state (i.e., no slurry pump operation, no waste additions or removal activities, and no/minor liquid additions per TSR Administrative Control 5.8.2.48.c), the only potential mechanism to increase the benzene release rate postulated in the DSA (chapter 18) is if the waste temperature increased above 35°C or below 1 Molar free hydroxide (OH^-). CSTF TSRs Administrative Control 5.8.2.48.f requires controls to maintain these waste temperature and free hydroxide limits. The High Level Waste Emergency Response Data and Waste Tank Data, N-ESR-G-00001, Table L-2, requires weekly temperature monitoring to ensure the 35°C temperature limit is maintained. Actual Round Sheets taken daily include Tank 48H temperature readings as well. Temperature data from Tank 48H was reviewed and shows, without running slurry pumps, the waste temperature stayed ~ 27°C during the summer of 2003 (June through August) and no evidence of any significant increase occurs. Table L-2 in N-ESR-G-00001 also requires corrosion control samples, which are used to obtain, in part, free OH^- levels, every 3 months. Samples taken on January 31, 2004, showed a free OH^- value of 1.45 molar and samples taken on April 22, 2004, showed a free OH^- value of 1.37 molar. No hydroxide additions were made between these dates. Thus, over a three month period, the free OH^- changed less than 0.1 molar. Based on this, for the duration of the Response Plan, there is no evidence to suggest the free OH^- level would approach 1 molar.

In accordance with CSTF TSR LCO 3.0.3, Tank 48H will remain in the Warm Standby mode while under the Response Plan. Additionally, Response Plan RP-HTF-04-001 maintains the same controls as specified in CSTF TSR LCO 3.3.1, Condition B, described above, except allows the time for restoration in c.2.2 above (i.e., within 7 days) to be out to August 16, 2004. This date was chosen since slurry pumps must be run on Tank 48H by August 26, 2004, in order to satisfy existing TSR Administrative Control 5.8.2.48.d requirements (performing this activity potentially increases the benzene release rate into the vapor space and the installed CLFL analyzer is required). Also, the current TSR LCO 3.3.1 action of monitoring the Tank 48H vapor space every 8 hours (action c.2.1 above) was allowed to have a 25% grace period. The Response Plan specifically prohibits this grace period as a compensation for extending the 7 days out to August 16. Note, too, that the alternate CLFL monitoring instruments to be used while under the Response Plan (portable Mine Safety Appliance monitors or Gas Chromatographs) are not from the same vendor as the installed CLFL analyzer and are not impacted by the new information affecting the installed CLFL analyzer.

Additionally, Response Plan RP-HTF-04-001 places restrictions on any Operations Surveillances and maintenance/construction activities which could cause the purge exhaust flow to be less than required (minimum flow specified in TSR LCO 3.2.10), except for the allowance to shift between purge exhaust fans, or impede the ability to perform CLFL monitoring as specified in the Response Plan. Any of these types of activities require a USQ determination to be performed before being conducted.

Based on the discussion above regarding Tank 48H temperature and free OH^- limits and trends, there is no expectation that the temperature or free OH^- levels will come close to approaching their respective limits while under Response Plan RP-HTF-04-001. Thus, DOE concludes the measures in place on Tank 48H are adequate to ensure the risk of storing waste in Tank 48H while under Response Plan RP-HTF-04-001 is equivalent to the risk previously approved by DOE.

5.0 Conditions of Approval

None.

6.0 Conclusions

Based on the evaluation documented in Section 4.0 of this SER supplement, DOE review of Response Plan RP-HTF-04-001 concludes the appropriate safety basis controls are identified and justified to protect the onsite workers, the general public, and the environment to an equivalent level of protection as afforded in the current DSA and TSRs. Therefore, the Response Plan submitted in Reference 1 is approved.

7.0 References

1. Letter, Olson to Hansen, "Submittal of the Tank 48 CLFL Analyzer Potential Inadequacy in Safety Analysis (PISA) and Associated Response Plan," CBU-LWD-2004-00025, June 4, 2004.

SEP 0 3 2004

Mr. R. A. Pedde, President
Westinghouse Savannah River Company
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Approving the Change in Gas Release Mode Definition

References:
1. Letter, Olson to Hansen, "Submittal of the Gas Release Safety Basis Changes to DOE," CBU-LWD-2004-00052, 6/9/04
2. Letter, Olson to Hansen, "Resolution of DOE Questions on the Gas Release Safety Basis Changes," CBU-LWD-2004-00059, 7/9/04

The Department of Energy Savannah River Operations Office (DOE-SR) has completed its review of the safety basis changes submitted in Reference 1. Based on the review, DOE-SR approves the submitted safety basis changes. The enclosed SER (Revision 0, Supplement 12) documents the results of the DOE evaluation and provides the basis for approval. Included within the enclosed SER supplement are two Revision Issues necessitating revisions to the CSTF Documented Safety Analysis (DSA) to capture the technical basis for resolution of the issues DOE-SR identified during our review as documented in Reference 2. These Revision Issues are expected to be incorporated no later than the next annual update to the CSTF DSA.

It is expected that the safety basis document changes submitted in Reference 1 will be added to the CSTF safety basis document manual, WSRC-IM-94-10, as effective safety basis documents within 90 days from the date of this letter.

Consistent with the conclusion reached in Reference 1, the CSTF Authorization Agreement does not require revision to incorporate the submitted safety basis document revisions.

The items in this letter have been discussed with David Little of your staff.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days.

SEP 0 3 2004

Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or have your staff contact Tom Temple at 208-8772.

Sincerely,

Original Signed By
Jeffrey M. Allison

Jeffrey M. Allison
Manager

WDED:TCT:kl

DC-04-056

Enclosure:
CSTF SER, Rev. 0, Supplement 12

cc w/o encl:
H. T. Conner, Jr., WSRC, 730-1B
W. J. Johnson, WSRC, 730-1B
W. S. Elkins, WSRC, 730-1B
W. S. Shingler, WSRC, 730-1B
J. C. DeVine, WSRC, 766-H

bcc w/encl:
D. Little, WSRC, 703-H
L. D. Olson, WSRC, 703-H
~~D. J. Blake, WDED~~
T. C. Temple, WDED
J. Smartt, SRPD, 730-B
R. J. Hardwick (EH-2), HQ

bcc w/o encl:
WDED Rdg File / AMWDP Rdg File
Mgr's Reading File / DMC Rdg File
ECATS, 730-B (MC #040869 & 041037)

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 12

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 2, via
HLW-CRF-04005, Revision 0

and

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2004-A

August 2004

Prepared by : Thomas C Temple
Thomas C. Temple

Reviewed by: Donald J Blake
Donald J. Blake

Approved by:
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 12

Executive Summary

The Contractor (Westinghouse Savannah River Company (WSRC)) submitted several proposed changes to the primary 10CFR830-compliant CSTF safety basis documents, the Documented Safety Analysis and Technical Safety Requirements in June 2004. The primary change involved a proposed change in the definition of whether a waste tank had to enter the Gas Release Mode prior to conducting certain types of activities which could cause release of trapped gas within the sludge or saltcake (e.g., sludge slurrying, saltcake dissolution, etc.). Several other minor changes were also proposed. DOE review of the proposed safety basis changes concluded no new hazards were introduced and the appropriate safety basis controls have been applied to protect the onsite workers, the general public, and the environment. DOE found the changes to satisfy the applicable review criteria used from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009 and DOE Guide G423.1-1. Additionally, the proposed changes did not invalidate any premise upon which DOE initially approved the Documented Safety Analysis and Technical Safety Requirements in December 2002. Therefore, the proposed CSTF safety basis changes submitted are approved. Two Revision Issues were identified requiring additional basis to be added to the CSTF Documented Safety Analysis to fully capture the basis for acceptability of the change in the Gas Release Mode definition. These were identified and addressed in section 4.1 of this SER and will be incorporated into the CSTF Documented Safety Analysis no later than the next annual update.

1.0 Introduction

The CSTF Safety Basis (SB) changes submitted via Reference 1 involve changes to the CSTF Documented Safety Analysis (DSA, WSRC-SA-2002-00007) and the CSTF Technical Safety Requirements (TSRs, S-TSR-G-00001) to address several general topics, specifically:

1. Redefinition of the Gas Release Mode and the analyses and control changes to support this redefinition
2. Additional Condition and allowable Action if ventilation systems have an operable backup HEPA filter installed
3. Recognition that the transfer path from the Receiving Basin for Offsite Fuel (RBOF) to H-Tank Farm is being isolated and HDB-3 is now an inactive location
4. Various changes and clarifications for consistency and overall DSA/TSRs improvement
5. Incorporate and supersede previous Change Request HLW-CRF-04002 (approved by DOE via SER, Revision 0, Supplement 10)

Detailed descriptions of the above revisions are provided in a table within Change Request HLW-CRF-04005 and the TSR Revision Log.

The specific safety basis documents submitted for review and approval are:

- CSTF DSA Change Request HLW-CRF-04005, Revision 0
- CSTF TSR Revision 2004-A

2.0 Review Process

This SER supplement is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

An outside Contributing Reviewer, J. Poppiti (DOE-EM), was used to support review of key references (WSRC-TR-2004-00052 and –00099) regarding the Gas Release Mode redefinition (discussed in detail in Section 4.1 below).

As a result of the DOE review of the DSA/TSR changes submitted in Reference 1, including supporting documents, DOE identified two areas requiring additional analyses regarding the redefinition of the Gas Release Mode. These two areas were discussed with the Contractor (WSRC), who documented in Reference 2 the need to complete additional confirmatory evaluations to support DOE review and approval. These additional confirmatory evaluations were completed and provided to DOE and are discussed in Section 4.1 below.

3.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, the various DSA sections were consistent, and the changes were consistent with the interface requirements with other facilities. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 (Reference 3) were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs: (1) are clear with respect to mode applicability and process area applicability; (2) provide adequate justification to support Limiting Conditions for Operation (LCO) conditions, actions and surveillance requirements; (3) provide clear administrative controls; and (4) are consistent with the accident descriptions and credited controls.

4.0 Evaluation

Each of the scopes of changes identified in Section 1.0 above was evaluated against the applicable criteria identified in Section 3.0.

4.1 Redefinition of the Gas Release Mode and all the analyses and control changes to support this redefinition

The current DSA recognizes that hydrogen bubbles (formed from radiolysis of water) become trapped within sludge or saltcake within the High Level Waste storage tanks (waste tanks). If the sludge or saltcake is disturbed (slurry pump agitation, dissolution of saltcake with water, etc.), the trapped hydrogen bubbles will be released. Depending on the amount of trapped hydrogen and the mechanism/rate of disturbance, the released hydrogen could form a transient flammable layer/region within the vapor space of the waste tank.

The current DSA recognizes that a plume or layer may form during gas release activities such as slurry pump operation, but the current DSA judged, based on earlier reports from Hanford, that the "actual flammable volume comprised only a small fraction of the total hydrogen volume released in the plume." Additionally, the current DSA concluded that "plumes will mix rapidly into the vapor space and that plumes are a safety hazard only if the volume of hydrogen in the plume is sufficient to raise the entire [bulk] vapor space to a significant fraction of the LFL [Lower Flammability Limit]." In recognition of the above potential, the current DSA requires that any waste tank that has enough trapped hydrogen, if instantly released and mixed into the bulk vapor space volume, to cause the bulk vapor space to reach/exceed 25% of the hydrogen LFL, ~1 vol% hydrogen, must be in the Gas Release Mode (GRM). Limiting the amount of trapped gas volume to an equivalent of 25% LFL in the bulk vapor space was judged to ensure the potential plume was "not a safety hazard." In Reference 3, DOE evaluated these current DSA conclusions and found them adequate and found the associated controls "to be adequate for preventing deflagrations in the waste tank primary vapor space."

Subsequent to the CSTF DSA being approved and implemented, the evaluations for a specific tank (Tank 11H) showed that the amount of trapped gas in the sludge could cause the bulk vapor space to reach ~30% LFL, but then the radiolytic hydrogen generation rate was such that, upon concurrent loss of ventilation, there were still 100+ days before 100% LFL would be reached. Thus, WSRC embarked upon an effort to determine if increasing the %LFL in the bulk vapor space which necessitated GRM designation was justifiable. Two key reports (WSRC-TR-2004-00052 and -00099) were developed to show that increasing the GRM criteria from 25% to 60% LFL in the bulk vapor space was justifiable. DOE reviewed these reports to determine whether the basic conclusion in the current DSA remained valid – that being although plumes/layers could possibly form, the volume/time at risk is still small and represents a minimal risk.

Report WSRC-TR-2004-00099 identifies three separate gas release scenarios which potentially could be of concern:

a. Persistent flammable stratified non-buoyant gas layer just above the waste surface
b. Flammable gas layers or pockets in the tank intermediate head space
c. Persistent flammable stratified buoyant gas layer at the tank top ceiling or dome

One scenario not deemed credible in the SRS waste tanks (either in the current DSA or the revisions submitted in Reference 1) is the type of severe "roll-over" type event previously seen in some Hanford tanks. Previous reports HLW-STE-99-0393 and WSRC-TR-2000-00017 compared SRS waste tanks and Hanford waste tanks and concluded this type of event was not

credible. No evidence since these reports were issued in 1999-2000 has been seen to warrant changing this conclusion.

Scenario "a" - Persistent flammable stratified non-buoyant gas layer just above the waste surface

Scenario "a" above was evaluated due to the observation in laboratory tests that irradiation of simulated saltcake could generate bubbles containing nitrous oxide (N_2O) and hydrogen (H_2), instead of the expected oxygen (O_2) and H_2 (although only observed in one experiment; others did not show evidence of forming N_2O). The N_2O-H_2 mixture could exceed the molecular weight of air in the tank headspace and collect near the surface of the waste. Field observations have not seen evidence of a non-buoyant layer being formed in SRS waste tanks. In particular, during a large supernate removal activity on Tank 37H performed in 2002, a Gas Chromatograph (GC) was installed and used to measure changes in hydrogen concentration. Based on the chemistry of the waste in Tank 37H, the bubbles formed due to radiolysis could have formed an N_2O-H_2 mixture versus the typical O_2-H_2 mixture. Hydrogen monitoring during the large supernate removal activity showed that trapped bubbles containing H_2 were released, but no evidence of non-buoyant gas release. Either N_2O-H_2 was not formed (if the waste in Tank 37H did not produce an N_2O-H_2 mixture, very unlikely any other tank would have) or, if some amount of N_2O-H_2 mixture was formed, its release did not behave in a non-buoyant fashion. The data collected (level changes versus hydrogen concentration changes) were specifically evaluated in Appendix B of WSRC-TR-2004-00099. If the released gas were to have behaved non-bouyantly, the time for the released gas to uniformly mix in the vapor space and be read by the GC should have been ~80 minutes. The GC data collected and evaluated shows a linear increase in hydrogen concentration and the time lag between start of the hydrogen release (i.e., start of supernate removal) and observation on the GC was well less than 80 minutes.

Thus, this postulated scenario is viewed as not credible. This conclusion is supported by the current controls that maintain the amount of organic material very low (organics promote N_2O formation). This conclusion also does not apply to Tank 48H, which contains tetraphenylborate (TPB) that breaks down into benzene. The analyses and controls for Tank 48H are unique and captured in Chapter 18 of the CSTF DSA.

Scenario "b" - Flammable gas layers or pockets in the tank intermediate head space

Scenario "b" above was evaluated to determine if global releases (i.e., releases over a significant portion of the waste surface area) could form flammable pockets or layers within the intermediate waste tank headspace, and, if so, whether these pockets/layers would persist for any appreciable amount of time. The release occurs over a significant portion of the waste surface such that little air from the vapor space can mix into the rising light gas from a horizontal direction (i.e., the tank walls prevent mixing other than in the vertical direction). The primary analysis for this scenario is a report by Fauske and Associates (FAI/03-06, Attachment F in WSRC-TR-2004-00052), which analyzed various gas release rates from sludge slurry over varying surface areas. Per Attachment A of WSRC-TR-2004-00099, the rate of global releases of trapped gas from sludge slurry bound the rate of global releases from saltcake and aged sludge. This conclusion reached in Attachment A of 2004-00099 is adequately supported by analysis and actual observations from releases from sludge slurry, aged sludge, and saltcake. Intuitively, sludge slurry is a "weaker" strength material so the ability to disturb large quantities quickly compared to salt cake and aged sludge makes sense.

The modeling performed in FAI/03-66 is based on bouyancy-driven turbulent diffusion of light gas (H_2-O_2 mixture in trapped gas bubbles being released) into an overlying dense gas (air). Additional mixing mechanisms such as thermal gradients, active ventilation, convective mixing (e.g., due to slurrying action on liquid surface), etc. are conservatively ignored. The basis for using this type of model for releasing light gas into a heavier gas is discussed in section 6.1 of FAI/03-66. DOE review of this basis found it adequate and supported by theory and experiments. Additionally, DOE reviewed the derivation of the key equations which provided:

(a) the release time of the trapped gas
(b) the time for the released gas to reach the tank ceiling
(c) the thickness of the layer within the released gas which was at or above LFL
(d) the time at risk (i.e., the time the released gas represented a layer above the LFL)

DOE found the derivation of these equations correct.

Three mechanisms of releases were investigated: (1) natural or spontaneous releases (occurs once settled slurry retains maximum gas possible); (2) planned agitation such as from slurry pump operation; and (3) a seismic-induced agitation. The following table summarizes key inputs/assumptions from the study on global releases and FAI/03-66 which factored into the four (4) equations above, and the DOE evaluation and conclusion regarding each:

Table 4.1-1, DOE Evaluation of Global Releases and FAI/03-66

Key Input/Assumption	**DOE Evaluation/Conclusion**
Maximum concentration of H_2 in trapped gas bubbles - 75%	This value is already in the DSA approved by DOE and is unaffected by the change is GRM definition.
The cases studied of sludge/supernate levels (given in Table 5-2 of FAI/03-66) are reasonable and conservative.	The combinations of sludge/supernate levels studied (range from ~50" to ~150" of freshly settled sludge slurry) bound typical sludge slurry batch size. The analysis results show the case of 1.3 m of sludge slurry covered with 1.3 m of supernate is close to the bounding case. WSRC-TR-2004-00099 shows that the "bounding" case would result in only a slight increase in flammable layer size/duration of existence.

Key Input/Assumption	DOE Evaluation/Conclusion
Mixing length to thickness proportionality coefficient – 0.164	Obtained from data through experiments where pure water was released into a brine solution over a global area and the diffusion process was observed. This coefficient was derived from these experiments as discussed in Reference 4. Theoretical derivation of the same parameter resulted in very good agreement (see Ref. 4). DOE review of this report found the value of 0.164 to be applicable and supported by these experiments.
Value of LFL – 3.7 vol% (0.037)	Temperature corrected LFL using existing formula in DSA section 3.4.1.1.2 and 100°C. Value was found to be appropriate and conservative.
Surface area of tank liquid – 526 m^2	Used surface area of Type IIIA tank (85' diameter – see W700853 (Tank 40H) for example), assuming no reduction from center column, cooling coils, etc. Tank surface area given in CSTF DSA Table 3.4-2 is 5492 ft^2, which equates to 510 m^2. Use of 526 m^2 is marginally non-conservative since, for the same volumetric release of gas, it would result in a slightly lower velocity. However, FAI/03-66 plotted velocity against time and showed the worst case was an intermediate velocity (3 to 4E-3 m/sec), so this intermediate velocity would be achieved by a slightly different (lower) slurry pump flowrate over the slightly smaller surface area.

Using the formulas derived and the inputs above, the trapped superficial gas release velocity was varied from 1E-5 m/sec (equates to a gas release rate of H_2-O_2 mixture of ~11 ft^3/min) up to ~0.03 m/sec (equates to a gas release rate of ~33,400 ft^3/min), and for each case (sludge/supernate height) the release time, time for the released gas to reach the tank ceiling, and the time at risk (time some portion of the released gas layer is at/above 100% LFL) were calculated and plotted. Two release velocities for Case 2 (middle case; 2.6m of sludge covered by 1.9m of supernate) were plotted to show the change in flammable layer thickness over time. DOE used these same formulas to plot the flammable layer thickness over time for Cases 2 and 3 (which bounded Case 1) for several different release rates shown to be worst cases in FAI/03-66. The results of this showed that Case 3 (1.3m sludge covered by 1.3m of supernate) bounded Case 2. Case 3 was bounding because, as stated above, the amount of trapped gas was limited to an equivalent of 60% LFL in the bulk vapor space. Since Case 3 had more vapor space, then more trapped gas was assumed in the shallower level of sludge. For the same release rate, since more trapped hydrogen was available in Case 3, the release occurs longer, feeding the growing layer of hydrogen for a longer period. Case 3 created the highest flammable layer (peaks ~1.4m (~20% of the vapor space)) and lasted the longest (~30 seconds theoretically).

Report WSRC-TR-2004-00099 identifies the fact that the conditions and results of Case 3 are not bounding, but very close to bounding, and estimates the bounding case to result in a flammable layer lasting ~45 seconds theoretically. The gas release velocities needed to produce the large flammable layers that last 30-45 seconds are shown to be in the range of 0.003 m/sec to 0.01 m/sec, which equate to hydrogen release rates of 2500 ft^3/min to 8360 ft^3/min.

These hydrogen release rates are far in excess of actual release rates during quiescent and sludge agitation activities. For example:

a. even if a tank were full (1.3E6 gallons) of waste with the bounding H_2 generation rate given in the DSA (1.5E-5 ft^3 of H_2/hr/gal of waste), the steady state (i.e., quiescent conditions with no trapped gas release) release rate would be < 1 ft^3/min
b. release rates during slurry pump operation on Tanks 40H and 51H due to trapped gas release have been 5-12 ft^3/min (reference calculations X-CLC-H-00408 and X-CLC-G-00056)

At these actual release rates, the corresponding release velocities are such that the flammable layer thickness and duration of existence are diminishingly small. There are two mechanisms theorized to obtain the high velocities necessary to form flammable layers that last any appreciable time:

1. A seismic event which quickly mobilizes all the settled sludge slurry and the bubbles rise at the maximum superficial velocity
2. Running slurry pumps (whether it be 1 ADMP in a Type IV tank, or 4 quad-volute pumps, or 2 SMPs in a Type I, II, or III/IIIA tank) which mobilize virtually all the trapped bubbles in the settled sludge slurry in a relatively short amount of time.

For the Seismic-induced potential scenario above, tanks containing sludge slurry (i.e., those tanks with the type of "weak" sludge necessary to be fully mobilized and quickly release the trapped bubbles) are under the current DSA Quiescent Time Program and the change in the Gas Release Mode definition does not alter the Seismic event controls.

For the slurry pump induced potential scenario above, the combination of conditions necessary to form the 45 second layer is judged very unlikely, if not impossible, especially the ability to mobilize the entire sludge volume in a short amount of time (when the sludge must also be "strong enough" to hold the postulated amount of trapped gas). Additionally, changing the GRM criteria from 25% to 60% LFL in the bulk vapor space does not prevent the formation of a layer of flammable gas forming since the superficial gas velocity can be the same (depending on sludge height, supernate height, and trapped gas void fraction) for each case. It does change the layer thickness and the time the flammable layer exists (~ linearly). Thus, the change in risk is, at worse, increasing the time a flammable layer exists from ~20 seconds to 45 seconds. Given the conservatisms in the modeling and inputs, the actual change is from a time much shorter than 20 seconds to a time much shorter than 45 seconds. DOE concludes this change in risk is negligible and is acceptable.

A final point worth discussing is that FAI/03-66 recognizes that the model and times presented are not purely applicable for the cases where the gas release layer (the mixing front) hits the tank dome/ceiling before the total release is over. This is shown in each of Figures 6-4, 6-5, and 6-6 of FAI/03-66. However, the times between these is very small and FAI/03-66 judged that a more refined model for this condition was not warranted. The judgement made was that the time at risk would not increase by more than ~20% (equating to a time at risk ~55 seconds). DOE evaluation of this judgement concluded it was reasonable and adequate.

Scenario "c" - Persistent flammable stratified buoyant gas layer at the tank top ceiling or dome

The third scenario (scenario "c") is similar to scenario "b" above, except that the release of trapped gas occurs over a fraction of the waste surface. In this case, as the trapped gas is released into the vapor space, air can enter the rising light gas from the horizontal direction as well as the vertical (i.e., the tank walls do not impede mixing from the horizontal direction). The concern here is whether the "plume" that forms is still flammable when it hits the tank ceiling/dome such that a persistent stratified buoyant layer is created at the tank ceiling/dome.

Based on theoretical and experimental work on turbulent diffusion modeling of light gas, as the light gas (H_2–O_2 mixture from the trapped bubbles in the waste) is released into heavier gas (air in tank vapor space) over a portion of the waste surface, the rising light gas forms a inverted cone-shaped "plume". Based on the work presented in FAI/98-50, the vast majority of mixing occurs in what is referred to as the "mixing layer", which exists up to a height ~0.55 times the radius of the release area. At this point, the plume turns vertical and the light gas continues to rise vertically, but much less mixing continues to occur (this region is referred to as the "vertical plume"). If the concentration of H_2 within the released gas is < 100% LFL where this mixing layer ends (i.e., at 0.55 times the release area radius), then the concentration at higher levels (i.e., within the "vertical plume") within the released gas will be < 100% LFL (i.e., no "re-concentration" of H_2 will occur – discussed further below). Note that a "layer" of flammable gas (≥100% LFL) within the "mixing layer" (i.e., a layer between the waste surface and some vertical height within the "mixing layer") may form. Report WSRC-TR-2004-00052 concludes that "although a stratified layer may persist, the time at risk during plume mixing is bounded by that of a global release." DOE review of this conclusion resulted in the need for additional evaluation (see Reference 2).

As a result, report CBU-LTS-2004-00086 was issued to document a more detailed comparison of the local plume release case and the global release case. This evaluation showed that the flammable gas volumes and durations involved in large local releases are bounded by global releases for comparable waste configurations, release conditions, and superficial gas velocities. For smaller release rates and volumes, the flammable durations of local releases exceed the time at risk during global release. However, the volume of the flammable gas region is small. This is due to the differences in physics involved in the two release mechanisms. For example, at a release velocity of 1E-3 ft/sec, the global release case would predict a flammable gas region lasting only ~8 seconds (for Case 3 in WSRC-TR-2004-00052). However, for similar conditions in a local release scenario, CBU-LTS-2004-00086 shows the flammable region within the mixing zone to last ~235 seconds, but the volume that is flammable is only 6 m^3 (~0.1% of the total vapor space volume). This results because the local release model assumes that as long as the mixing zone is being fed with flammable gas (i.e., the H_2 within the released trapped bubbles), a flammable layer continues to exist within the mixing zone.

DOE review of CBU-LTS-2004-00086 concluded that the time at risk of having a significant flammable gas volume during a local release scenario is comparable to the time at risk during a global release scenario. Even with conservative assumptions, these times are on the order of 1-2 minutes or less. For tanks where this condition could exist often and repeatedly (sludge processing tanks 40H and 51H), changing the GRM definition from 25% LFL to 60% LFL does not change the total risk exposure time. With a GRM criteria of 25% LFL, the volume of

a potential flammable layer would be less and the time this flammable layer exists would be less than if a 60% LFL criteria were used, but the slurry pumps have to be run more often to keep from building up trapped gas that exceeded 25% LFL in the vapor space. Thus, the number of times this smaller volume/duration layer was formed increases. On an annual basis, the total time at risk would be the same.

The results/conclusions in CBU-LTS-2004-00086 need to be captured in the DSA basis for acceptability of the Gas Release Mode definition. Thus, the following Revision Issue has been identified to be incorporated into the CSTF DSA no later than the next annual DSA update.

Revision Issue CSTF-0-12-R1: Revise the CSTF DSA to include the results/conclusions in CBU-LTS-2004-00086, either directly or by reference, no later than the next annual DSA update.

For the combinations of gas release areas, gas release rates, and available head space heights where the "mixing layer" fully forms, the methodology for establishing at what height the released light gas starting out above LFL becomes less than LFL is given in FAI/98-50 (and restated in WSRC-TR-2004-00052, Attachment A). Obviously, as the release area increases, the height necessary to fully form the mixing layer increases. For some combinations of release area and gas release rate and available tank head space heights, the "mixing layer" cannot fully form and the equations derived in FAI/98-50 were not completely valid. For these combinations, Attachment A of WSRC-TR-2004-00052 derived a modified methodology (based on the same principles and theory) to determine at what height the released light gas starting out above LFL becomes less than LFL (in this case, this height would still be within the "mixing layer" region). Using these two methodologies from Attachment A in WSRC-TR-2004-00052, curves relating the release area of gas from the waste surface to gas release rate from the waste surface for various tank head space heights were generated to show whether the plume would be flammable at the tank ceiling/dome.

DOE reviewed the methodologies in WSRC-TR-2004-00052, as well as the supporting theory and experimental work in FAI/98-50, and concluded these methodologies were technically sound, supported by adequate theory and experimental work, and were applicable to the scenario at hand (i.e., release of trapped bubbles of H_2–O_2 into the tank vapor space).

One area of potential concern identified by DOE was whether the predictions of the height of the flammable layer (whether within the "mixing layer" or within the "vertical plume") properly considered the physical mixing phenomenon within the center of the overall inverted conical plume. Especially for large local release scenarios, it seemed possible that the center of the mixing layer would not experience the amount of mixing experienced in the outer sections (sort of a "self-shielding" effect). DOE expressed this concern and WSRC took action (see Reference 2) to have an independent review of the equations used to predict the behavior of released light gas within the mixing layer and the vertical plume. This independent review concluded that the equations used to develop the local release gas behavior were conservative and adequate within the mixing layer. Regarding the vertical plume equations, FAI/98-50 used a "top hat" (i.e., uniform) distribution across the vertical plume diameter to represent the light gas concentration profile. The author of FAI/98-50, as well as the independent reviewer for WSRC, recognized that this light gas concentration profile within the vertical plume could look somewhat like a Gaussian distribution across this diameter (see Reference 5 and supporting

reference SRNL-LWP-2004-00022). Thus, theoretically, the center of the vertical plume could have a higher H_2 concentration than at the outer edge of the vertical plume. However, two arguments were made to justify that use of the uniform (average) top hat profile was adequate in determining whether a local release would cause a persistent flammable layer at the tank ceiling:

1. in order for the light gas profile to achieve a significant Gaussian look, the gas would need to travel about 6-10 vertical plume diameters. For the cases of concern (i.e., fairly large local releases (e.g., release diameter of 10 meters)), the vertical plume diameter would be 4.3 meters (relationship between the vertical plume diameter and release area diameter is 0.43 per FAI/98-50). Thus, for a Gaussian profile to form, the light gas would have to travel vertically greater than the tank height. Even for a smaller release diameter of 5 meters, the vertical travel distance would be over 10 meters, which is about the height of the tank.
2. once the light gas profile hit the tank ceiling, it would continue to entrain air as the light gas plume spreads out over the ceiling surface. Thus, in a relatively short amount of time the profile would be uniform by physical constraint. Independent review report SRNL-LWP-2004-00022 concluded that the subsequent average concentration of the light gas would be less than or equal to the concentrations calculated using the methodology from FAI/98-50.

DOE reviewed the basis provided to justify use of the uniform, top-hat approach (CBU-LTS-2004-00087 and SRNL-LWP-2004-00022) and concluded this approach was adequate. The results/conclusions in these two reports need to be captured in the DSA basis for acceptability of the Gas Release Mode definition. Thus, the following Revision Issue has been identified to be incorporated into the CSTF DSA no later than the next annual DSA update.

Revision Issue CSTF-0-12-R2: Revise the CSTF DSA to include the results/conclusions in CBU-LTS-2004-00087 and SRNL-LWP-2004-00022, either directly or by reference, no later than the next annual DSA update.

As mentioned above, no re-concentration of H_2 at the tank ceiling/dome is postulated. Report WSRC-TR-2004-00052 references a previous report (WSRC-RP-91-95) for the basis of this conclusion. DOE reviewed this previous report and found it to be based on sound gaseous molecular physics, and thus concurred that H_2 re-concentration is not credible.

As in the case for scenario "b" above, several key assumptions were made in the construction of the flammability curves discussed above. Table 4.1-2 identifies these and provides the DOE evaluation of their adequacy.

Table 4.1-2, DOE Evaluation of Local Release Flammability Curve Methodology in WSRC-TR-2004-00052, Attachment A

Key Input/Assumption	**DOE Evaluation/Conclusion**
Maximum concentration of H_2 in trapped gas bubbles - 75%	This value is already in the DSA approved by DOE and is unaffected by the change is GRM definition.

Key Input/Assumption	DOE Evaluation/Conclusion
Plume entrainment coefficient - 0.12	This value was empirically derived as discussed in FAI/98-50. Value is in agreement with theoretical derivation as well, as discussed in FAI/98-50. DOE review of this report found the value of 0.12 to be applicable and supported by these experiments.
Mixing length to thickness proportionality coefficient – 0.14	Obtained from data through experiments where pure water was released into a brine solution over a localized area and the diffusion process was observed. This coefficient was derived from these experiments as discussed in FAI/98-50. Theoretical derivation of the same parameter resulted in very good agreement (see FAI/98-50). DOE review of this report found the value of 0.14 to be applicable and supported by these experiments.
Value of LFL – 3.7 vol% (0.037)	Temperature corrected LFL using existing formula in DSA section 3.4.1.1.2 and 100°C. Value was found to be appropriate and conservative.

Once the curves were generated to show how much head space was required to ensure a persistent stratified buoyant flammable layer at the tank ceiling/dome would not be created, curves predicting the height of flammable gas within the mixing layer and/or vertical plume for release areas/release rates from different slurry pump speeds/combinations were created. Attachment B of WSRC-TR-2004-00052 derives these curves based on equations presented in FAI/98-50.

Again, several key assumptions were made in the construction of these gas release curves discussed above. Table 4.1-3 identifies these and provides the DOE evaluation of their adequacy.

Table 4.1-3, DOE Evaluation of Local Release Gas Release Curve Methodology in WSRC-TR-2004-00052, Attachment B

Key Input/Assumption	DOE Evaluation/Conclusion
Maximum concentration of H_2 in trapped gas bubbles within sludge slurry - 75%	This value is already in the DSA approved by DOE and is unaffected by the change is GRM definition.
Pump Jet entrainment coefficient - 0.08	This value was empirically derived as discussed in FAI/98-50. Value is in agreement with theoretical derivation as well, as discussed in FAI/98-50. DOE review of this report found the value of 0.08 to be applicable and supported by these experiments.
Value of LFL – 3.7 vol% (0.037)	Temperature corrected LFL using existing formula in DSA section 3.4.1.1.2 and 100°C. Value was found to be appropriate and conservative.
Friction factor for slurry pump jet flow against immobilized slurry material - 0.01	Friction factors for highly turbulent flow over engineered surfaces range from 2.5E-3 for smooth surfaces to 1.5E-2 for very rough surfaces. Friction factor is in numerator of gas release rate equation, so a larger value is conservative. Chosen value of 1.0E-2 is on conservative end of range and judged adequate. [reference Boundary-Layer Theory, 1987, by Schlichting, from McGraw-Hill]

Key Input/Assumption	DOE Evaluation/Conclusion
Density of settled slurried sludge - 1250 kg/m^3	Derived assuming slurry was 85 vol% supernate at 1.05 spgr and 15 vol% solids at 2.4 spgr. Also equivalent to a solution of 20 wt% insoluble solids with specific gravity of 5 and 80 wt% supernate with specific gravity of 1.05.
Yield stress of settled slurried sludge – varied from 5 Pa to 50 Pa.	A yield stress of 3.0 Pa corresponds to a constituency of whole milk. Assuming this constituency would retain up to 12 vol% trapped gas is very conservative. Settled sludge slurry that traps gas is estimated to have yield stresses in the range of 30-50+ Pa.
Diameter of slurry pump nozzle – 0.11176 m (4.4")	SMP is bounding pump type. Vendor file VPF AC18290A, Design Review Report 7048A, EMD Shop Order V016.
Flowrate through nozzle – 0.479 m^3/sec (3800 gpm)	SMP is bounding pump type. Vendor file VPF AC18290A, Design Review Report 7048A, EMD Shop Order V016.

A geometrical assumption was necessary to derive the effective gas release area, the assumption being this release area is represented by a circle with diameter equal to the pump jet entrainment length. Additionally, the gas release rate also needed to account for conditions where only a portion of the pump jet engages sludge slurry (e.g., at high pump flowrates in shallow sludge layers, part of the theoretical jet cone volume formed is above the sludge). Finally, for conditions where two pumps could be simultaneously directed at each other when pumping at high velocities, the entrained bubbles from each pump could be released from the same waste surface area. Thus, cases were run in which the release rate was doubled. These geometric assumptions are adequately discussed and justified in Attachment B of WSRC-TR-2004-00052.

With the equations and assumptions discussed above, curves were developed showing release areas versus release rates for different tank head space conditions and plotted against the flammability curves for the same head space conditions. Curves were also developed where the non-fixed variables were increased/decreased individually by a factor of 1.5 and then simultaneously by a factor of 1.25 to ascertain sensitivity [jet velocity increased, pump jet nozzle elevation decreased and submergence decreased, assumed gas fraction increased, release area decreased (for same release rate which effectively increased the release velocity)]. These sensitivity analyses showed that the results were fairly insensitive to significant changes in these variables.

Finally, gas release curves were generated to address slurry pump operation within aged sludge, which range in yield stress from 50 Pa up to 500 Pa, for cases where the slurry pump nozzle was "free" (nozzle centerline at sludge surface) or "buried" (nozzle below sludge surface). The "free" nozzle release case is not as severe since ½ of the pump jet cone does not disturb the sludge.

The results of the analyses described above are summarized as:

1. For <u>fresh sludge slurry tanks</u> (i.e., those tanks under a Q-Time Program such as the tanks preparing sludge for feed to DWPF), the existing structural fill limits provide sufficient vapor space height such that even the conservative model shows no stratified buoyant

flammable plume can form at the tank ceiling/dome, regardless of type/number/output of slurry pumps.

2. For aged unwashed sludge tanks (those tanks containing unwashed sludge (trapped bubble H_2 concentration of $\leq$ 37.5%) which are not under a Q-Time program), if the pump nozzle is "free", the existing structural fill limits provide sufficient vapor space height such that even the conservative model shows no stratified buoyant flammable plume can form at the tank ceiling/dome, regardless of type/number/output of slurry pumps.
3. For aged unwashed sludge tanks (those tanks containing unwashed sludge (trapped bubble H_2 concentration of $\leq$ 37.5%) which are not under a Q-Time program), if the pump nozzle is "buried", then at least 2 m of head space is required to ensure no stratified buoyant flammable plume can form at the tank ceiling/dome, regardless of type/number/output of slurry pumps.
4. For aged washed sludge tanks (those tanks containing washed sludge (trapped bubble H_2 concentration of > 37.5%) which are not under a Q-Time program), if the pump nozzle is "free", then at least 1 m of head space is required to ensure no stratified buoyant flammable plume can form at the tank ceiling/dome, regardless of type/number/output of slurry pumps.
5. For aged washed sludge tanks (those tanks containing washed sludge (trapped bubble H_2 concentration of > 37.5%) which are not under a Q-Time program), if the pump nozzle is "buried", then at least 4 m of head space is required to ensure no stratified buoyant flammable plume can form at the tank ceiling/dome, regardless of type/number/output of slurry pumps.

Additional factors that make these results conservative:

a. model assumes bubble concentration was 75% H_2 (except for analyses of unwashed sludge, which assumed bubble concentration was 37.5% H_2), whereas maximum calculated is ~60%
b. model assumes slurry is inviscid (negligible viscosity) yet is thick enough to retain significant trapped gas
c. model assumes bubbles remain at optimum size (~ large) so their velocity is high, whereas some of the bubbles within the waste traveling through the pump impeller as well as some of those bubbles entrained in the pump jet will be sheared into smaller size bubbles, which will release into the vapor space at a lower velocity

Report WSRC-TR-2004-00052 also relates the above results for sludge to tanks containing saltcake. Section 3.3.4 of this report provides adequate comparisons of different kinds of salt dissolution processes and concludes that the results above for sludge bound saltcake dissolution techniques where water (whether inhibited or uninhibited) is introduced above the saltcake surface (even if slurry pumps were used in conjunction with this water addition). Adding inhibited water above the saltcake has been the typical SRS technique used for saltcake dissolution. Report WSRC-TR-2004-00052 is very clear that the analyses, results, and conclusions presented are not necessarily valid if water is added at high rates below the saltcake surface. Section 3.4.2.11.1 of the DSA was revised to define the standard method of saltcake dissolution as addition of water above the salt surface and then specifically refers to report WSRC-TR-2004-00052. Thus, if an activity were proposed to add water below the saltcake surface, the USQ process would be applied to evaluate the activity and ensure it was within the bounds of report WSRC-TR-2004-00052.

Based on the results and conclusions presented in reports WSRC-TR-2004-00052 and –00099, the following changes were made throughout the DSA and TSRs (e.g., DSA Chapters 3, 4, and 5; TSR Definitions, Modes, LCOs, Bases, Administrative Controls):

1. revised the Gas Release Mode definition in the DSA/TSR to require entry into this mode if the release of trapped gas due to planned sludge agitation, salt dissolution, or interstitial liquid removal would (Figures 4.1-1 through 4.1-6 below illustrate the following):
   a. exceed 60% LFL in the waste tank bulk vapor space, or
   b. cause the waste tank flammability classification criteria to be violated (i.e., less than 7 days to reach LFL for Rapid Generation Tank, less than 28 days to reach LFL for Slow Generation Tank, become flammable for Very Slow Generation Tank).
2. revised the DSA/TSR to require the Flammability Control Program to derive the required LFL analyzer setpoint to protect items 1.a and 1.b above and to document these setpoints in the HLW Emergency Response Data and Waste Tank Data document (ERD, N-ESR-G-00001). The existing DSA/TSR requires the LFL analyzer setpoint to protect a constant value of 25% LFL. Since the LFL analyzer setpoint may vary to protect 1.b above, a single setpoint is no longer viable. This also resulted in the TSR LCOs addressing LFL setpoints to reference the ERD (N-ESR-G-00001) instead of specifying the values directly. This is similar to what is already done in LCO 3.8.4 for where the HLLCP setpoints are specified since they vary tank-to-tank too. DOE finds this practice acceptable and adequate.
3. revised the DSA/TSR to remove the allowance for Tanks 8F, 40H, 42H, and 51H to have certain exceptions to the required interlocks specified for all other waste tanks while in the GRM. The existing DSA/TSR allowed these four tanks to not have certain hardware while in the GRM (e.g., Tank 40H was not required to have a safety class loss of ventilation flow interlock to stop slurry pumps). These allowances have been eliminated, such that now all tanks requiring entry into the GRM will require the same controls (and none of the existing controls for all the other tanks were changed or deleted) for the applicable trapped gas release activity (i.e., planned sludge agitation, salt dissolution, or interstitial liquid removal).
4. revised the DSA/TSR to replace the requirement to perform 12 vapor space turnovers prior to conducting planned sludge agitation, salt dissolution, or interstitial liquid removal activities with a requirement to determine and conduct the proper number of vapor space turnovers. The existing DSA/TSR requirement of 12 vapor space turnovers was based on reducing an initial vapor concentration of 25% LFL to the value assumed in the GRM determination evaluation (typically 2.5% LFL). Since the initial vapor space concentration may now vary (up to 60% LFL), the number of vapor space turnovers to reduce the initial vapor concentration to the value assumed in the GRM determination evaluation is variable. The methodology used to determine the appropriate number of vapor space turnovers has not changed and is referenced in the DSA, and is consistent with the methodology specified in NFPA-69.
5. revised the DSA to include the required fill limits for each type tank (I, II, III/IIIA, and IV) for each type of waste (e.g., tanks under a Q-Time Program, saltcake, aged unwashed sludge, aged washed sludge) to ensure persistent stratified buoyant flammable gas layers are not formed at the tank ceiling/dome. Also revised the DSA/TSR administrative control for determining the HLLCP setpoint to recognize this additional factor to ensure the most limiting fill limit is specified for each tank.
6. Revised DSA sections 5.5.4.2.29 and .30, consistent with References 6 and 7, to explain the rationale as to why the Pump Run and Salt Dissolution/Interstitial Liquid Removal Programs were selected as part of the first level of control (safety class) for certain

postulated waste tank hydrogen explosion events over hydrogen analyzer interlocks. Two key bases exist for this selection: (1) the ventilation system flowrate is not necessarily adequate for all potential trapped gas release rates (as discussed above, the modeled gas release rates into the tank vapor space can be quite high); and (2) since the trapped gas release rates can potentially be high, the LFL analyzer would only address the high H_2 condition after the trapped gas release challenged the imposed 60% LFL limit (i.e., a mitigator versus a preventor). The only viable means of keeping the waste tank within the confines of the analysis (i.e., a preventive control) is to administratively control the amount of trapped flammable gas and/or to control the release of this trapped gas to the rate/quantity assumed in the analysis. This is done via the combination of waste tank ventilation and the Pump Run and Salt Dissolution/Interstitial Liquid Removal Programs. DOE found the rationale provided in sections 5.5.4.2.29 and .30 to be appropriate and adequate.

Case 1 – release of trapped gas exceeds 60%; GRM required regardless of subsequent time to reach LFL (T_{LFL})

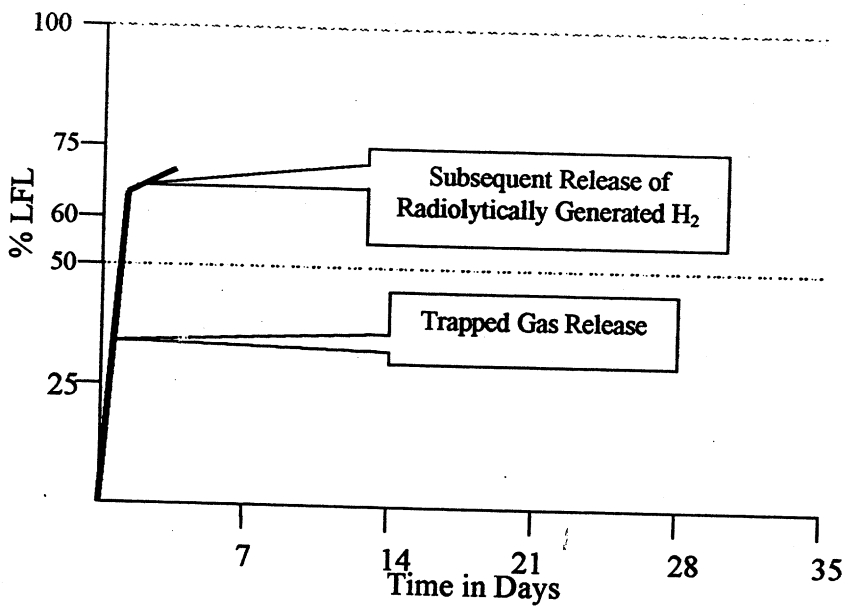

Figure 4.1-1

Case 2 - Release of trapped gas is < 60% LFL but causes T_{LFL} to be less than 7 days. GRM entry required and interlock setpoint must be derived to ensure T_{LFL} from setpoint to 100% LFL is at least 7 days.

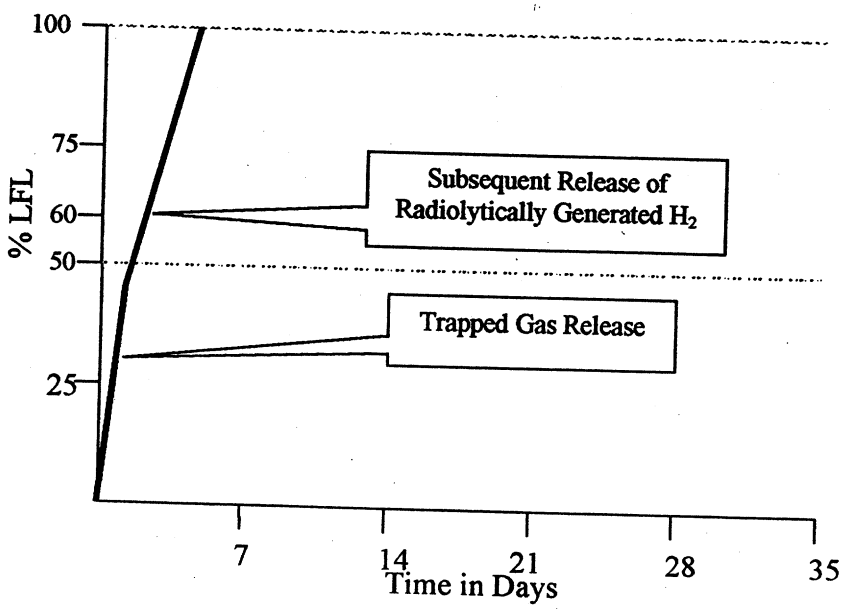

Figure 4.1-2

Case 3 – Release of trapped gas < 60% LFL and T_{LFL} is greater than or equal to 7 days but less than or equal to 28 days. GRM entry not required, but Rapid Generation Tank (RGT) controls applicable.

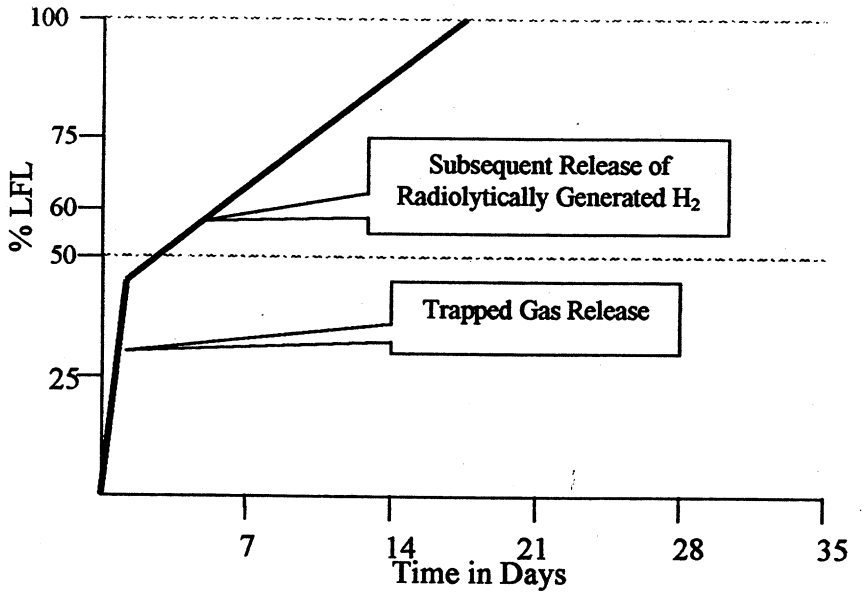

Figure 4.1-3

Case 4 – Release of trapped gas < 60% LFL and T_{LFL} > 28 days. GRM entry not required but Slow Generation Tank (SGT) controls applicable.

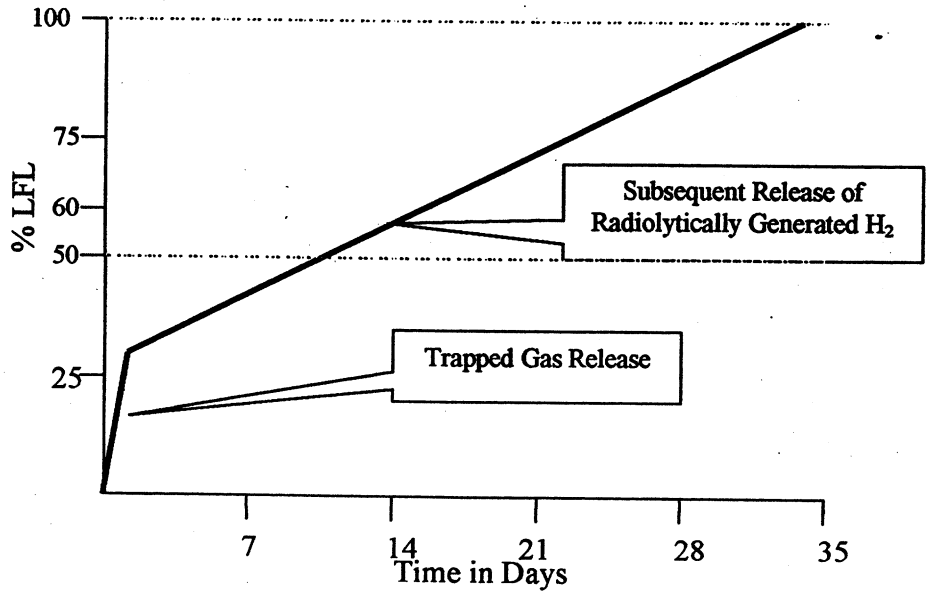

Figure 4.1-4

Case 5 – Release of trapped gas < 60% LFL and tank never reaches 100 % LFL. GRM entry not required and only Very Slow Generation Tank control (HLLCP to protect vapor space) applicable.

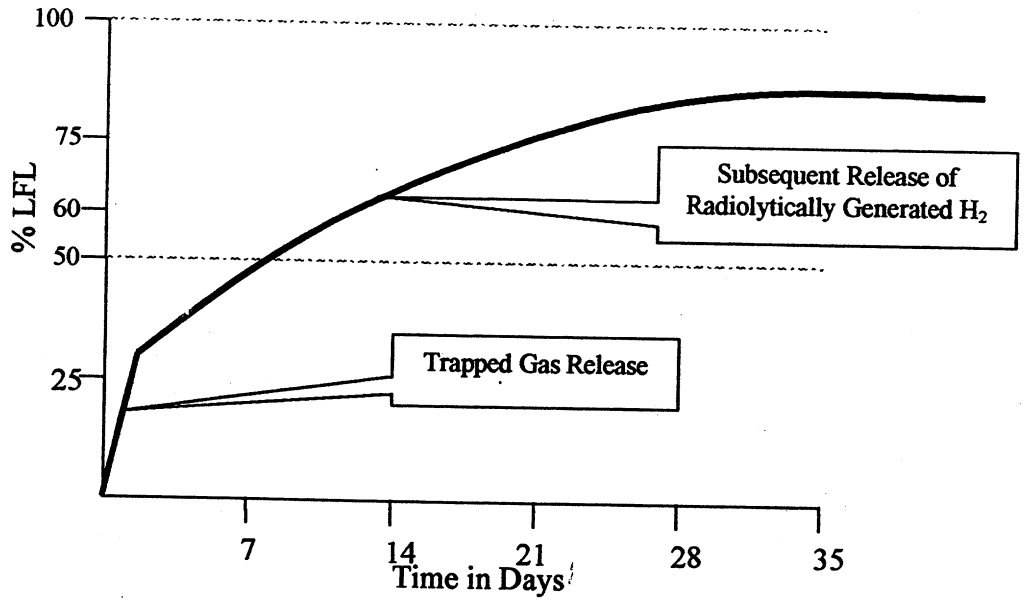

Figure 4.1-5

Case 6- Example of tank re-classification versus GRM entry – No trapped gas release, tank is SGT. With trapped gas release < 60% LFL, tank is RGT. IF tank classification is kept as SGT for trapped gas release activity, (e.g. slurring sludge), tank would enter GRM. Another option would be to reclassify tank as RGT and then conducting trapped gas release activity would not have to enter GRM.

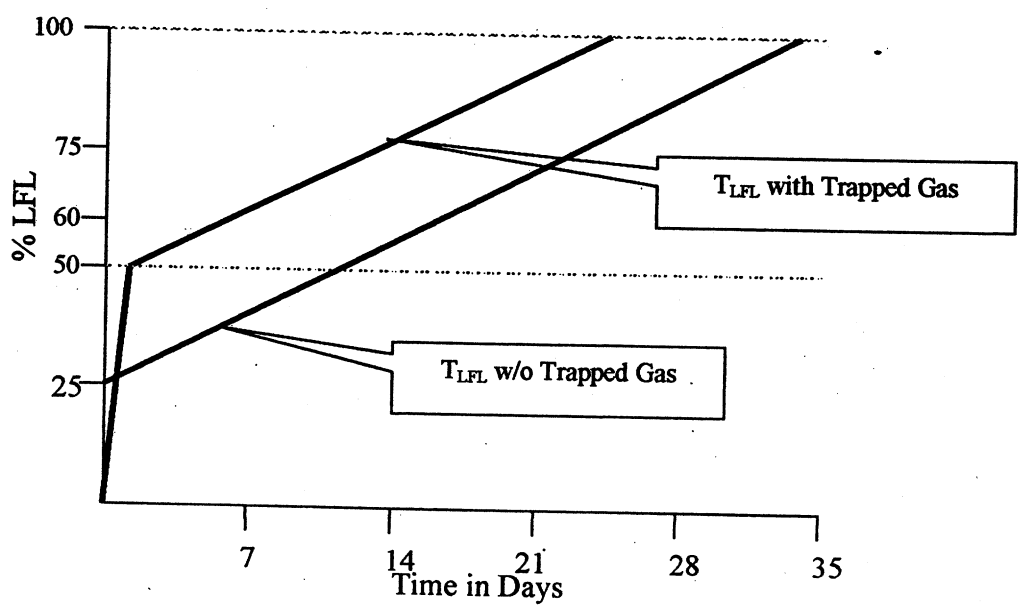

Figure 4.1-6

4.2 *Additional Condition and allowable Action if ventilation systems have an operable backup HEPA filter*

Active ventilation systems for certain locations (diversion boxes, pump tanks/pits, and waste tanks) are identified in DSA Chapter 3 as performing a safety significant function to provide filtered releases to reduce radioactive consequences for certain events. As described in DSA Chapter 4, performing this SS function does not require redundancy. Thus, the requirements specified in DSA Chapter 4 and the Limiting Conditions for Operation (LCOs) derived in DSA Chapter 5, only necessitated one HEPA filter. The current LCOs would require the immediate termination of transfers, agitators, steam jet operation, etc. if the HEPA filter became inoperable. However, some of these credited systems do, in fact, have two HEPA filters in parallel. Thus, to take advantage of redundancy that exists, DSA Chapter 5 and the corresponding TSR Limiting Conditions for Operation (LCOs) were revised to create a separate Condition if the on-line HEPA filter becomes inoperable and allows the installed operable standby HEPA filter to immediately be placed into service. Switching to the installed operable standby HEPA filter is quick, straightforward, and is a routine activity. Thus, this change does not change any risk acceptance from DOE.

DOE reviewed the affected sections in DSA Chapter 5 and the TSR LCOs and concluded the appropriate changes were made, they were consistent and clear, and were fully supported by the accident analyses in DSA Chapter 3 and the system performance requirements in DSA Chapter 4.

4.3 *Recognition that the transfer path from the Receiving Basin for Offsite Fuel (RBOF) Facility to Tank 23H has been isolated and HDB-3 now being an inactive location*

The RBOF Facility previously sent very dilute, low activity waste to Tank 23H via HDB-3. The RBOF Facility will no longer send this waste to the Tank Farm and a plant modification (P-DCF-H-01532) is cutting and capping the line between the RBOF Facility and diversion box HDB-3. Thus, the DSA is being changed to reflect this source of influent no longer exists. Additionally, the DSA and TSRs are revised to show HDB-3 is no longer in active service (i.e., it is added to the list of "inactive locations") and thus is prohibited from having any waste transferred to/through it.

DOE reviewed the DSA and TSR changes and found that all the appropriate sections were modified to reflect the change in RBOF Facility influent and HDB-3 status.

4.4 *Various changes and clarifications for consistency and overall DSA/TSRs improvement*

DOE reviewed each of the changes in this category and found each to be appropriate. All but one (discussed below) of the changes in this category had no effect on any event frequency, consequence, or margin of safety previously approved by DOE. Examples of the types of changes in this category were:

a. clarified, actually enhanced, the discussion in DSA section 3.4.1.5.2 regarding waste stream characterization into/out of pump tanks with and without agitation.
b. added to DSA section 3.4.1.5.3 the methodology (formula) to show the amount of organics in a waste stream entering the CSTF meets the criteria of $\leq$ 5% contribution to the H_2 LFL. The added formula was found to be consistent with the supporting calculation S-CLC-G-00270, previously reviewed by DOE as part of SER Revision 0 (Reference 3).

c. clarified the safety function of the HDB-8 ventilation system and clearly show the required interlock on associated Figure 4.4-4 as a follow-up corrective action from Occurrence Report SR-WSRC-HTANK-2003-0042.
d. clarified the Transfer Control Program discussion in DSA Chapters 3 and 5, as well as the TSR Administrative Control Program, to specifically require material balances for all waste transfers greater than 15,000 gallons (except those directly to/from the evaporator pot), in addition to leak detection provisions.
e. revised the TSR Administrative Control for the Transfer Control Program to include the attribute to verify available space in the receipt tank prior to the transfer, to make consistent with the existing DSA Chapter 5 requirement.
f. clarified free supernate removal prohibitions to ensure siphon potentials are to be considered (appropriate and conservative change).
g. recognized that waste tank sampling can be done using powered equipment such as a hydraulic sampling system (reviewed and appropriately shown to be a non-USQ via TRC-WPT-2004-00011).
h. revised the material at risk discussion for the seismic-induced steam heated pump tank scenario in DSA section 3.4.2.13 to be internally consistent (one paragraph stated seismic-induced scenario postulated steam leak for 2 hours whereas another paragraph stated seismic-induced scenario not credible; supporting calculation and remainder of DSA section 3.4.2.13 concluded not credible).
i. modified completion time for TSR LCO 3.3.1, Action B.3.1, from 12 Hours to 8 Hours, to be consistent with Action B.3.2.1, as a result of Occurrence Report SR-WSRC-HTANK-2004-0008.
j. modified DSA section 3.4.2.11.1 on Waste Tanks Undergoing Planned Salt Dissolution to be consistent with discussion in this same section for Planned Sludge Agitation and with DSA section 5.4.3 regarding the fact that there are certain activities which dissolve saltcake, but the quantities are negligibly small such that an engineering evaluation prior to conducting each activity is not required. Examples given include: flushing equipment, sample rinsing, filling purge condenser seal leg, etc.). This consistency change also provided a needed clarification that for transfers into a salt tank with exposed salt peaks to be of negligible concern relative to trapped gas release the salt peaks must be "small" and defines this as the height and base of the peak are "inches" not "feet".)
k. modified DSA section 3.4.2.18.5 to move existing Event Response Program control from Safety Significant Controls section to Safety Class Controls section. This was appropriate since a part of the Event Response Program (e.g., installation of portable ventilation systems on waste tanks post-earthquake) fulfilled an identified safety class function.

One revision in this category did change (increase) the consequences reported in the DSA. DSA section 3.4.2.20 postulated a Loss of Offsite Power (LOOP) event and reported a mitigated offsite dose of zero rem (each event potentially initiated by a LOOP was prevented). However, one of the events potentially initiated by a LOOP identified was an explosion in a pump tank. Identified controls to prevent pump tank explosions were the pump tank ventilation systems. However, the pump tank ventilation systems were identified in section 3.4.2.20 as safety significant since they were only credited to prevent explosions for onsite workers (similar to DSA section 3.4.2.8). No safety class control was identified to prevent or mitigate pump tank explosions relative to the offsite public because the unmitigated consequences of a pump tank explosion was well below the 25 rem Evaluation Guideline specified in DOE-STD-3009 (actual conservatively calculated offsite consequence was 0.66

rem in DSA section 3.4.2.8). To reconcile this discrepancy, DSA section 3.4.2.20 was modified to postulate sludge slurry (worst case material at risk) transfers going on through two pump tanks when a postulated LOOP occurs (similar to the assumptions used in DSA sections 3.4.2.17 (Tornado) and 3.4.2.18 (Seismic)) and both pump tanks becoming flammable and exploding. The resulting offsite consequences would then be 1.32 rem. This new consequence is reported in the revised section 3.4.2.20 and the summary consequence table (Table 3.4-7). Although this is an increase in the reported consequences, the results are still well below the 25 rem EG and no change in control strategy or functional classification of controls is warranted.

4.5 Incorporate and supersede previous Change Request HLW-CRF-04002

Previous Change Request HLW-CRF-04002 modified the DSA to (1) remove the exclusion that the top 40" of sludge slurry did not retain trapped hydrogen, and (2) replace the assumption that the hydrogen retention rate was a constant 50% of the hydrogen generation rate with the assumption that the hydrogen retention rate was 50% of the hydrogen generation rate for sludge levels ≤ 90" and 100% for sludge levels > 90". These DSA changes were reviewed and approved in DOE SER Revision 0, Supplement 9. DOE review of Change Request HLW-CRF-04003 ensured the text from HLW-CRF-04002 was properly carried into HLW-CRF-04003. The technical review and acceptance for these changes remains in Supplement 9 and is not repeated here.

5.0 Conditions of Approval

None.

6.0 Conclusions

Based on the evaluation documented in Section 4.0 of this SER supplement, DOE review of the SB changes concludes no new hazards were introduced and the appropriate SB controls have been applied to protect the onsite workers, the general public, and the environment. DOE found the changes to satisfy the applicable review criteria used from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009 and DOE Guide G423.1-1. Additionally, the proposed changes did not invalidate any premise upon which DOE approved DSA/TSR Revision 0. Therefore, the proposed CSTF DSA and TSR changes submitted in Reference 1 are approved. Two Revision Issues were identified requiring additional basis to be added to the CSTF DSA to fully capture the basis for acceptability of the change in GRM definition. These were identified and addressed in section 4.1 of this SER and will be incorporated into the CSTF DSA no later than the next annual DSA update.

7.0 References

1. Letter, Olson to Hansen, "Submittal of the Gas Release Safety Basis Changes to DOE," CBU-LWD-2004-00052, 6/9/2004.
2. Letter, Olson to Hansen, "Resolution of DOE Questions on the Gas Release Safety Basis Changes," CBU-LWD-2004-00059, 7/9/2004
3. Letter, Allison to Pedde, "DOE CSTF SER Rev. 0," PC-03-008, 12/20/2002
4. Epstein and Burelbach, "Transient Vertical Mixing by Natural Convection in a Wide Layer," International Journal of Heat and Mass Transfer 43, 2000, pages 321-325.
5. Memorandum, Freed to Lex, "Impact of Gas Release Model Choice on Headspace Requirements for Slurry Pump Operation in Sludge and Aged Slurry Tanks," CBU-LTS-2004-00087, 8/19/2004.
6. Memorandum, Roberson to Distribution, "Environmental Management Guidelines and Lessons Learned for Nuclear Facility Safety Control Selection and Implementation," 5/20/2003.
7. Letter, Pedde to Allison, "5-Day Response to Your Letter: 'Environmental Management Guidelines and Lessons Learned for Nuclear Facility Safety Control Selection and Implementation,'" WSR-2003-00122, 7/15/2003.

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

NOV 18 2004

Mr. Robert A. Pedde, President
Westinghouse Savannah River Company
Aiken, South Carolina 29808

Dear Mr. Pedde:

SUBJECT: Submittal of the Hydrogen Monitoring Safety Basis Changes to DOE

References:
1. Letter, Olson to Hansen, (CBU-LWD-2004-00086), 10/18/04
2. My Letter, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) Approving the Change in Gas Release Mode Definition," (DC-04-056), 09/03/04

The Department of Energy Savannah River Operations Office (DOE-SR) has completed its review of the safety basis changes submitted in Reference 1. Based on the review, DOE-SR approves the submitted safety basis changes. The enclosed Safety Evaluation Report (SER) (Revision 0, Supplement 13) documents the results of the DOE evaluation and provides the basis for approval. Included within the enclosed SER supplement is one Revision Issue necessitating a revision to the Concentration, Storage, and Transfer Facilities (CSTF) Documented Safety Analysis (DSA) to resolve text discrepancies between various DSA sections. This Revision Issue is expected to be resolved no later than the next annual update to the CSTF DSA.

It is recognized that the safety basis changes approved via Reference 2 may not be implemented within 90 days of the date of Reference 2 since several implementing documents are impacted by both change packages and it is desirable to implement both packages simultaneously to minimize the facility impacts. Therefore, it is expected that the safety basis document changes submitted in Reference 1 and the changes approved via Reference 2 will be added to the CSTF safety basis document manual, WSRC-IM-94-10, as effective safety basis documents within 60 days from the date of this letter.

Consistent with the conclusion reached in Reference 2, the CSTF Authorization Agreement does not require revision to incorporate the submitted safety basis document revisions.

The items in this letter have been discussed with David Little of your staff.

The action taken herein is considered to be within the scope of the existing contract and does not authorize the Contractor to incur any additional costs (either direct or indirect) or delay delivery to the Government. If the Contractor considers that carrying out this action will increase contract costs or delay any delivery, the Contractor shall promptly notify the Contracting Officer orally, confirming and explaining the notification in writing within five (5) working days.

Following submission of the written notice of impacts, the Contractor shall await further direction from the Contracting Officer.

If you have any questions, please contact me or have your staff contact Don Blake at 208-8245.

Sincerely,

Jeffrey M. Allison
Manager

WDED-05-08

Enclosure:
CSTF SER, Rev. 0, Supplement 13

cc w/o encl:
W. J. Johnson, WSRC, 730-1B
H. T. Conner, Jr., WSRC, 730-1B
J. C. DeVine, WSRC, 766-H
W. S. Shingler, WSRC, 730-1B
L. J. Simmons, WSRC, 730-1B

cc w/encl:
D. Little, WSRC, 703-H
L. D. Olson, WSRC, 703-H

Enclosure to ltr., Allison to Pedde
dated: NOV 18 2004

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 13

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 2, via
HLW-CRF-04011, Revision 0

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2004-B

AND

CSTF JUSTIFICATION FOR CONTINUED OPERATIONS

WSRC-TR-2003-00083, Revision 2

November 2004

Prepared by : Donald J. Blake
Donald J. Blake

Reviewed by: Thomas C. Temple
Thomas C. Temple

Approved by:
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 13

Executive Summary

The Contractor (Westinghouse Savannah River Company (WSRC)) submitted proposed changes to the 10CFR830-compliant CSTF safety basis documents, the Documented Safety Analysis (DSA), Technical Safety Requirements (TSR), and Justification for Continued Operations (JCO). The primary change involves eliminating the requirement to perform hydrogen gas monitoring on Rapid Generation Tanks using the installed hydrogen monitor. Hydrogen monitoring will still be required, but will be performed using a portable instrument (as is currently done on Slow Generation Tanks). DOE review of the proposed safety basis changes concluded no new hazards were introduced and the appropriate safety basis controls have been applied to protect the onsite workers, the general public, and the environment. DOE found the changes to satisfy the applicable review criteria used from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009 and DOE Guide G423.1-1. Additionally, the proposed changes did not invalidate any premise upon which DOE initially approved the Documented Safety Analysis and Technical Safety Requirements in December 2002. Therefore, the proposed CSTF safety basis changes submitted are approved.

1.0 Introduction

The CSTF Safety Basis (SB) changes submitted via Reference 1 involve changes to the CSTF Documented Safety Analysis (DSA, WSRC-SA-2002-00007), the CSTF Technical Safety Requirements (TSRs, S-TSR-G-00001), and the CSTF Justification for Continued Operations (JCO, WSRC-TR-2003-00083) to delete the requirement for installed hydrogen monitors on Rapid Generation Tanks. Hydrogen monitoring will be performed utilizing a portable instrument which is consistent with the existing requirement for Slow Generation Tanks. Detailed descriptions of the above revisions are provided Change Request HLW-CRF-04011 and the TSR Revision Log.

The specific safety basis documents submitted for review and approval are:

- CSTF DSA Change Request HLW-CRF-04011, Revision 0
- CSTF TSR Revision 2004-B
- CSTF JCO Revision 2

2.0 Review Process

This SER supplement is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1A, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

3.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, the various DSA sections were consistent, and the changes were consistent with the interface requirements with other facilities. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 (Reference 2) were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs: (1) are clear with respect to mode applicability and process area applicability; (2) provide adequate justification to support Limiting Conditions for Operation (LCO) conditions, actions and surveillance requirements; (3) provide clear administrative controls; and (4) are consistent with the accident descriptions and credited controls.

The JCO was reviewed to ensure the changes to the discussion of LFL monitor calibration for benzene (for Tank 50) are consistent with the uncertainty of the instrumentation and apply the appropriate multiplication factors to account for the possible presence of benzene. The review ensured that the risk previously accepted by DOE via SER Supplement 1 (for JCO Revision 0) and SER Supplement 4 (for JCO Revision 1) has not increased and that the compensatory measures are still appropriate for the proposed changes.

4.0 Evaluation

DSA Section 3.4.2.11 (Waste Tank Explosion) credits periodic hydrogen monitoring as a safety significant second level of control for preventing a waste tank explosion. As stated in this DSA section, periodic hydrogen monitoring provides additional validation of the effectiveness of the safety class first level of control (waste tank ventilation and/or tank breathing). The waste tank structure provides the mitigative third level of control. The current DSA/TSR requires periodic hydrogen monitoring on Rapid Generation Tanks (tanks that can go from 25% to 100% LFL in less than 28 days following loss of ventilation) using installed LFL monitors. Monitoring of Slow Generation Tanks (tanks that can go from 25% to 100% LFL in greater than or equal to 28 days following loss of ventilation) is performed using Measuring and Testing Equipment (M&TE) LFL monitors (i.e., portable). For waste tanks undergoing sludge mixing, interstitial liquid removal, or salt dissolution where the flammable vapor concentration could exceed 60% LFL or become flammable following a trapped gas release within the minimum time to LFL as defined by the tank classification (see Reference 3 for details of this function), continuous monitoring is performed using an installed LFL monitor with control room alarms and interlocks (to stop slurry pumps, transfer pumps, close water addition valves) on high LFL and low sample flow.

The proposed changes submitted via Reference 1 eliminate the requirement for using the installed monitor for periodic monitoring on Rapid Generation Tanks when not in Gas Release Mode and specifically states to use M&TE LFL monitors. The current CSTF DSA/TSR only requires the

installed LFL monitor to be "operable" every 24 hours during performance of the surveillance (TSR SR 4.8.2.2) to ensure the tank vapor space is below the tank specific established LFL limit (i.e., the facility literally could perform the surveillance, then disconnect/isolate the installed monitor until 24 hours later). No credit is taken for operability of the installed monitors between surveillances and DSA section 5.5.2.2 specifically states that the installed monitors are not required to be operable between surveillances. This posture is consistently reflected in the DOE SER Revision 0 (Reference 2).

One potential concern raised during the DOE review of the proposed change involved potential inadvertent acid addition to a Rapid Generation Tank in between the periodic surveillances (which could lead to higher hydrogen concentrations). As shown below, the margin in the existing analysis and controls can tolerate a reasonable amount of inadvertent acid addition and changing from an installed device used every 24 hours to a portable device used every 24 hours does not change any basis on which DOE approved the safety posture in the DSA/TSR.

- There is no credit given to the installed LFL monitors for detecting extra hydrogen generation from an inadvertent acid addition from the Canyons or from DWPF. The credited protection against inadvertent acid additions causing invalidation of the safety basis control scheme is the Waste Acceptance Criteria (WAC) Administrative Program.
- Potential inadvertent acid additions from the Canyons would normally go thru a pump tank (with its own ventilation system) prior to being transferred to a waste tank.
- Even if an inadvertent acid transfer was made (assuming a reasonable volume) in between 24 hour surveillances using the portable M&TE LFL monitor, the waste tank ventilation flow requirement includes handling the release of dissolved hydrogen from a steam jet transfer. The transfer from DWPF is performed with a pump, so this term would not exist and the DSA concluded the Canyon transfer path would not introduce dissolved hydrogen to the Tank Farm either. Thus, some amount of hydrogen production from acid addition could be handled by the waste tank ventilation system [note that calculation S-CLC-G-00258 shows that the dissolved hydrogen production term was greater than the radiolytic hydrogen production term in deriving the minimum ventilation purge rate]. If the ventilation system failed in between portable LFL monitoring and acid was inadvertently received, unless this acid receipt caused very substantial hydrogen production, the next 24 hour surveillance would detect the increased hydrogen (assuming it caused the vapor space to go above the LFL limit), there would still be several days left before reaching LFL.

DSA Chapter 4 was appropriately revised to be consistent with the Chapter 3 control changes. When an installed monitor is required for Gas Release Mode, DSA Section 4.4.32.3 has been revised to require a SIL-1 Level calculation based on vendor reliability data as well as operability and failure data from existing analyzers in the facility to assure analyzer, alarm, and interlock reliability. This additional requirement is appropriate due to the reporting of several hydrogen analyzers failing calibration checks over the last several months (see SIRIM SR-WSRC-HTANK-2004-0019). DOE will review and evaluate these calculations on a case-by-case basis.

DSA Table 4.4-2 (Safety Significant Evaluations) describes the various design requirements that were considered when determining if the component/system satisfies its safety function, whether the component/system satisfies the requirements, and the technical basis for the evaluation. In the proposed change package, the bases for Design Requirements 2 (Equipment Environment

Consideration) and 3 (Functionality) for the Waste Tank LFL Monitor and High Hydrogen Concentration Indicator/Alarm/Interlock (Section 4.4.32) are inconsistent with the text in DSA Section 4.4.32.3. Specifically, with respect to Equipment Environment Consideration, DSA Section 4.4.32.3 requires a periodic loop check and calibration to compensate for components that are susceptible to degradation or failure as a result of harsh chemical or radiological conditions. However, DSA Table 4.4-2 simply states the environmental conditions will not impact the equipment's ability to perform its safety function. In addition, with respect to Functionality, DSA Table 4.4-2 states the hydrogen monitor and indicator/alarm/interlock were designed, constructed, and tested to safety significant criteria. However, DSA Section 4.4.32.3 states only the Interlocks are designed, procured, installed, tested, and maintained as safety significant equipment. The inconsistency between the DSA text in Section 4.4.32.3 and DSA Table 4.4-2 is identified as a **Revision Issue (CSTF-0-13-R1)**.

Consistent with the DSA changes described above, TSR LCO 3.8.2 (Hydrogen Monitoring – Rapid Generation Tanks – Operation) was revised to eliminate the requirement for an installed hydrogen monitor to be operable when used to monitor the hydrogen concentration per the surveillance requirements. The modified LCO simply states the vapor space hydrogen concentration shall be less than or equal to the LFL limit stated in the Emergency Response Data (ERD; N-ESR-G-00001). The only surveillance requirement remaining states to perform this verification using a portable LFL monitor every 24 hours. The surveillance frequency is the same as was required when using an installed monitor. The basis sections associated with this surveillance (B3.8.2/4.8.2.2 and B3.8.3/4.8.3.1) were revised to require a pre and post instrument check to validate proper operations and accuracy of the portable LFL analyzer. The surveillance is not satisfied until the post check of the instrument is successfully completed. The portable LFL monitor is currently being used to monitor LFL concentrations on Slow Generation Tanks, as well as to perform a weekly (every 7 days) instrument loop check of the installed hydrogen monitors (Surveillance Requirement 4.8.2.3). DOE observed performance of the hydrogen monitoring using a portable LFL monitor on a High Level Waste Tank (Tank 49 – a Rapid Generation Tank), including the pre and post instrument checks using a calibration gas, and considers the process and procedure adequate to ensure the safety function of detecting a high hydrogen concentration will be satisfied.

An additional TSR change was made to the Bases Section (B3.7.8) for LCO 3.7.8 (Pump Tank Pulse Tube Agitator Interlock) to reflect a modification to the weight factor dip tube leg. The modification (shortening of the dip tube leg by 6 inches and flaring the end) is shown in U-DCF-F-00115 and its purpose is to minimize the potential for pluggage. The instrument uncertainty calculation (J-CLC-F-00306) was revised (Revision 3) to account for the dip tube leg modification. The TSR required setpoint of 22 inches WC did not change as a result of the modification. DOE reviewed the instrument uncertainty calculation (J-CLC-F-00306, Revision 3) and confirmed the required setpoint was not impacted by the modification.

JCO Revision 2 was also submitted via Reference 1 to require the portable hydrogen monitor reading (on Tank 50) be adjusted to account for the potential presence of benzene. This is done by applying a multiplication factor (similar to the gain that is applied to the Tank 48 CLFL monitor) to the portable LFL monitor reading. Compensatory measure 5.0.5 was revised to require this adjustment. DOE review found this JCO revision necessary and appropriate. There is no increase in the risk previously accepted by DOE associated with the proposed changes.

The proposed changes submitted are based upon the DOE approved Gas Release DSA/TSR package (HLW-CRF-04005, Revision 0; S-TSR-G-00001 Revision 2004-A; and DOE SER Revision 0, Supplement 12). The Gas Release DSA/TSR package has not yet been implemented in the facility since many of the same documents will be affected by the Reference 1 submitted package. Therefore, upon approval of the Reference 1 package, these two DSA/TSR change packages will be implemented at the same time. DOE review of the Reference 1 package ensured that the changes previously approved in SER Supplement 12 (Reference 3) were not invalidated.

5.0 Conditions of Approval

None.

6.0 Conclusions

Based on the evaluation documented in Section 4.0 of this SER supplement, DOE review of the safety basis changes concludes no new hazards were introduced and the appropriate controls have been applied to protect the onsite workers, the general public, and the environment. DOE found the changes to satisfy the applicable review criteria used from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009 and DOE Guide G423.1-1. Additionally, the proposed changes did not invalidate any premise upon which DOE approved DSA/TSR Revision 0 or any subsequent supplements. Therefore, the proposed CSTF DSA, TSR, and JCO changes submitted in Reference 1 are approved. One Revision Issue was identified that requires resolution of an inconsistency between different sections in DSA Chapter 4 regarding equipment functional evaluation. The issue is described in Section 4.0 of this SER and will be resolved no later than the next annual DSA update.

7.0 References

1. Letter, Olson to Hansen, "Submittal of the Hydrogen Monitoring Safety Basis Changes to DOE," CBU-LWD-2004-00086, 10/18/2004.
2. Letter, Allison to Pedde, "DOE CSTF SER Rev. 0," PC-03-008, 12/20/2002
3. Letter, Allison to Pedde, "CSTF Safety Evaluation Report (SER) Approving the Change in Gas Release Mode Definition," DC-04-056, 09/03/2004.

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

MAR 0 9 2005

Mr. Robert A. Pedde, President
Westinghouse Savannah River Company
Aiken, South Carolina 29808

Dear Mr. Pedde:

SUBJECT: Submittal of the 2004 Concentration, Storage, and Transfer Facilities (CSTF) Annual Update and Unreviewed Safety Question (USQ) Annual Report

References:
1. Letter, Olson to Hansen, "Submittal of the 2004 Concentration, Storage, and Transfer Facilities (CSTF) Annual Update and Unreviewed Safety Question (USQ) Annual Report (U)," (CBU-LWD-2004-00114), 12/17/04
2. Letter, Olson to Hansen, "Submittal of Page Changes for Technical Safety Requirement Revision 2004-C (U)," (CBU-LWD-2005-00021), 1/21/05
3. Letter, Olson to Hansen, "Submittal of Page Changes for Technical Safety Requirement Revision 2004-C and Revisions 2005-A and 2005-B (U)," (CBU-LWD-2005-00024, 2/25/05)

The Department of Energy Savannah River Operations Office (DOE-SR) has completed its review of the CSTF Documented Safety Analysis (DSA) Revision 3 and Technical Safety Requirements (TSR) Revisions 2004-C, 2005-A and 2005-B transmitted in the referenced letters. Based on the review, DOE-SR approves the submitted safety basis documents. The enclosed Safety Evaluation Report (SER) documents the results of the DOE-SR evaluation and provides the basis for approval. One existing Revision Issue will remain open and is expected to be resolved prior to placing the next waste tank into the Removed From Service Mode.

It is expected that the DSA and TSR Revision 2004-C will be incorporated into the Safety Basis Document List (WSRC-IM-94-10) as Safety Basis Documents within 90 days of the date of this letter. It is recognized that TSR Revisions 2005-A and 2005-B will be maintained as configuration controlled documents in the Safety Basis Document List until such time as the ventilation modifications are implemented in the facility, which is expected to be by the end of 2005. Upon implementation of the modifications, the TSR revisions will be incorporated as Safety Basis Documents. Consistent with the conclusion reached in the referenced letters, the CSTF Authorization Agreement does not require revision to incorporate the submitted safety basis document revisions.

The action directed herein is considered to be within the scope of work of the existing contract. If the Contractor considers that carrying out this direction will increase contract costs or delay any delivery, the Contractor shall promptly notify me orally, confirming and explaining the notification in writing as soon as possible, but within no more than five working days. Following oral notification and submission of the written notice of impacts, the Contractor shall await further direction from me.

MAR 0 9 2005

If you have any questions, please contact me or have your staff contact Don Blake at 208-8245.

Sincerely,

Jeffrey M. Allison
Manager

WDED-05-23

Enclosure:
CSTF SER Revision 0, Supplement 14

cc w/o encl:
H. T. Conner, Jr., WSRC, 730-1B
W. J. Johnson, WSRC, 730-1B
L. J. Simmons, WSRC, 730-1B
W. S. Shingler, WSRC, 730-1B
J. C. DeVine, WSRC, 766-H
G. T. Wright, WSRC, 773-A

MAR 0 9 2005

SAFETY EVALUATION REPORT
REVISION 0, SUPPLEMENT 14

FOR THE
SAVANNAH RIVER SITE

CONCENTRATION, STORAGE, AND TRANSFER FACILITIES (CSTF)

OPERATED BY WESTINGHOUSE SAVANNAH RIVER COMPANY UNDER CONTRACT NO. DE-AC09-96SR18500

CSTF DOCUMENTED SAFETY ANALYSIS

WSRC-SA-2002-00007, Revision 3

AND

CSTF TECHNICAL SAFETY REQUIREMENTS

S-TSR-G-00001, Revision 2004-C
S-TSR-G-00001, Revision 2005-A
S-TSR-G-00001, Revision 2005-B

February 2005

Prepared by : Donald J. Blake
Donald J. Blake

Reviewed by: Thomas C. Temple
Thomas C. Temple

Approved by:
Michael A. Mikolanis, Director
Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

CSTF SAFETY EVALUATION REPORT (SER)
REVISION 0, SUPPLEMENT 14

Executive Summary

The Contractor (Westinghouse Savannah River Company (WSRC)) submitted the 10CFR830 required annual update to the CSTF safety basis documents, the Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR) via Reference 1. The primary changes involve the incorporation of a higher hydrogen generation rate (with commensurate additional controls) in waste tanks associated with processing of Sludge Batch 4 (Tanks 40 and 51). Outstanding change requests (either previously DOE approved or not requiring DOE approval as shown through the Unreviewed Safety Question (USQ) Screening/Evaluation process) have been incorporated into this DSA/TSR Revision. In addition, various clarifications and editorial corrections were made throughout the safety basis documents. WSRC subsequently submitted Reference 2, which includes additional TSR clarification and consistency changes discovered while preparing for implementation of the annual update. During the DOE review, it was mutually agreed upon that clarification was needed with respect to the level of control adequacy for a valve box explosion event. In addition, WSRC identified an implementation issue relative to modifications on Tanks 40 and 51 ventilation systems. WSRC requested a delay in the SER approval via Reference 8 until these two issues were resolved. WSRC then submitted DSA page changes and TSR Revisions to the annual update package via Reference 9 that resolved these issues. DOE review of the proposed safety basis changes concluded no new hazards were introduced and the appropriate safety basis controls have been applied to protect the onsite workers, the general public, and the environment. DOE found the changes to satisfy the applicable review criteria used from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009 and DOE Guide G423.1-1. Additionally, the proposed changes do not invalidate any premise upon which DOE initially approved the Documented Safety Analysis and Technical Safety Requirements in December 2002. Therefore, the proposed CSTF safety basis changes submitted are approved.

1.0 Introduction

The CSTF Safety Basis (SB) changes submitted via References 1, 2 and 9 involve changes to the CSTF Documented Safety Analysis (DSA, WSRC-SA-2002-00007) and the CSTF Technical Safety Requirements (TSRs, S-TSR-G-00001) to incorporate additional controls associated with processing higher hydrogen generating waste (e.g., Sludge Batch 4), outstanding safety basis change requests, and various clarifications and editorial corrections throughout the documents.

The specific safety basis documents submitted for review and approval are:

- CSTF DSA Revision 3 (includes incorporation of the following Safety Basis Change Requests)
    - HLW-CRF-04002 (DOE approved via SER Revision 0, Supplement 10)
    - HLW-CRF-04003 (TRC-WPT-2004-00011)
    - HLW-CRF-04004 (TRC-FTF-2004-00031)
    - HLW-CRF-04005 (DOE approved via SER Revision 0, Supplement 12)
    - HLW-CRF-04006 (USQ-HTF-2004-00263)
    - HLW-CRF-04007 (TRC-WPT-2004-00172)
    - HLW-CRF-04008 (TRC-WPT-2004-00286)
    - HLW-CRF-04009 (Submitted as part of DSA Revision 3 for DOE approval)

- HLW-CRF-04010 (TRC-HTF-2004-00537 and USQ-HTF-2004-00136)
- HLW-CRF-04011 (DOE approved via SER Revision 0, Supplement 13)

- CSTF TSR Revision 2004-C
- CSTF TSR Revision 2005-A
- CSTF TSR Revision 2005-B

2.0 Review Process

This SER supplement is prepared by the DOE Savannah River Operations Office (SR) in accordance with guidance from DOE-STD-1104-96, "Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports," and Savannah River Implementing Procedure (SRIP) 421.1, "Nuclear Safety Oversight". The Manager, SR is the approval authority for this SER supplement based on Savannah River Manual (SRM) 300.1.1B, "U.S. Department of Energy Savannah River Operations Office Human Resources Program Management Manual," Chapter 1, "Functions, Responsibilities, and Authorities Procedure."

3.0 Review Criteria

The DSA revisions were reviewed to ensure the changes were supported by the hazard analysis and associated accident descriptions, the appropriate controls were identified and applied for prevention/mitigation, the requirements were clear, the appropriate DSA sections were properly modified, the various DSA sections were consistent, and the changes were consistent with the interface requirements with other facilities. Specific review criteria used were from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009. Additionally, the bases established in the DOE CSTF SER Revision 0 (Reference 3) were reviewed to ensure the proposed changes did not invalidate any premise upon which DOE approved DSA Revision 0.

The TSR revisions were reviewed to ensure compliance with appropriate DOE criteria (DOE Guide G423.1-1, the safe harbor in 10CFR830, Subpart B), technical accuracy, and that any associated risk was acceptable. Review criteria were selected based on the scope of the change being evaluated. Accordingly, this change was reviewed to ensure the TSRs: (1) are clear with respect to mode applicability and process area applicability; (2) provide adequate justification to support Limiting Conditions for Operation (LCO) conditions, actions and surveillance requirements; (3) provide clear administrative controls; and (4) are consistent with the accident descriptions and credited controls.

4.0 Evaluation

4.1 Sludge Batch 4

The DSA currently bounds the hydrogen generation rate for sludge slurry at 1.5E-05 ft^3/hr-gal. Future sludge batch planning has discovered that this value is not bounding for all future sludge batches. Calculation X-CLC-H-00213, Rev. 1 was generated to determine a more reasonably conservative hydrogen generation rate value. The calculation concluded that 5E-05 ft^3/hr-gal is a reasonably conservative maximum hydrogen generation rate for sludge slurry. This is based on the planned washing of sludge to 1.0M sodium. The NOeff used in the hydrogen generation rate calculation is 0.25M (1.0M/4). Although this generation rate (5E-05 ft^3/hr-gal) is not bounding for all of the individually calculated waste generation rates, system planning for waste processing anticipates the need for blending of high heat sludge with lower heat sludge. DOE review of the

calculation has found the assumptions to be reasonably conservative and the methodology consistent with DSA Section 3.4.1.1.2. For example, sludge slurry is assumed to be 18 wt% insoluble solids. Based on analyses referenced in the calculation, this value bounds all previous sludge batches and is used as a basis assumption for spilled waste in the DSA. Eighteen wt% insoluble solids is the upper range of sludge slurry that can be transferred without appreciable settling of the solids in the transfer piping. F-Area Tank Farm (FTF) sludge slurries are limited to 16.7 wt% solids. In the Reference 1 submittal, Calculation X-CLC-H-00213 Revision 2 (February 2004) is listed as Reference 196 in DSA Chapter 3. However, Revision 1 (February 2004) is the latest issued revision to this calculation. This discrepancy was corrected in the subsequent Reference 9 page changes submitted to DOE.

The generation of an Extended Sludge Processing (ESP) Sludge Slurry waste category has resulted in additional and revised controls due to the higher hydrogen generation rate associated with this waste. These revised and additional controls include:

- An additional attribute of the Transfer Control Program for flushing the core piping following ESP Sludge Slurry transfers from Tank 51 to Tank 40 is required to protect the assumed hydrogen generation rate for the transfer path.
- An additional attribute of the Transfer Control Program requires that ESP Sludge Slurry shall only be transferred along leak checked paths shown in new DSA Figure 3.7-1. This Figure depicts a transfer path from Tank 51 through the Tank 51 Valve Box, through H-Area Diversion Box (HDB)-7, into Tank 40, then out of Tank 40 through the Tank 40 Valve Box to the Low Point Pump Pit.
- The Waste Tank Ventilation System flow rates for Tanks 40 and 51 (when they contain ESP Sludge Slurry) will be at least 188 scfm (measured using installed flow indication), versus 72 scfm for Rapid Generation Tanks and 45 scfm for Slow Generation Tanks, to minimize the potential to reach the flammable vapor concentration in the tank vapor space. Calculation S-CLC-G-00258 was revised (Revision 1) to determine this new minimum ventilation flow rate for waste tanks containing ESP Sludge Slurry. DOE review of the calculation found that Revision 1 used the same methodology (substituting a higher hydrogen generation rate) as previously reviewed by DOE (Revision 0 of the calculation) and documented in DOE SER Revision 0 (Reference 3). The inputs and assumptions were found to be reasonable and conservative.
- The integrity of the transfer line (Safety Class (SC)) traversing the Tank 40 annulus is credited with ensuring primary waste confinement during an ESP Sludge Slurry receipt. The associated transfer line jacket (SS) is credited with preventing any leaks from entering the annulus during an ESP Sludge Slurry receipt. The Annulus Conductivity probes, with control room alarm, are Safety Significant (SS) and are credited for notification of a waste leak during an ESP Sludge Slurry receipt. In a seismic event, the transfer line jacket and encasement are credited with providing airborne waste confinement following a primary containment (core pipe) waste release. These additional controls are required since the receipt transfer line traverses the Tank 40 annulus space and the ESP Sludge Slurry has a higher hydrogen generation rate (resulting in higher accident consequences since the annulus explosion event is now credible) than other transfers.
- Additional activities prohibited include ESP Sludge Slurry transfers to waste tanks other than 40 and 51, and jetted transfers into waste tanks containing ESP Sludge Slurry. Only Tanks 40 and 51 ventilation systems have been analyzed to satisfy the flow rates required for the higher hydrogen generation rates. The hydrogen generation rates do not account for

the release of dissolved hydrogen due to steam jetted transfers into ESP tanks. Therefore, these restrictions are considered adequate and appropriate.

- As a result of the higher hydrogen generation rate for ESP Sludge Slurry, DSA Table 3.4-1 was revised to reflect a smaller residual volume for HDB-7 (that protects an equilibrium hydrogen concentration of 25% of the Lower Flammability Limit (LFL)), and an equilibrium hydrogen concentration of >100 % LFL for Tank 40 and 51 Valve Boxes (an increase from >45 %) and 62% for the Tank 51 Drain Valve Box (an increase from 25 %). This will result in a lower conductivity probe setpoint (the 2nd level of control for the valve box explosion scenario in DSA Section 3.4.2.7) in the High Level Waste Emergency Response Data and Waste Tank Data document (N-ESR-G-00001). For the valve boxes, the probes will be set as low as possible (on the floor or within 1 inch of the floor), regardless of the hydrogen generation rate of the material being transferred. The small size of the Tank 40/51 Valve Boxes does not allow a probe setpoint that would maintain the equilibrium hydrogen concentration <100% LFL in the event of a leak of ESP Sludge Slurry. DSA Section 3.4.2.7 (Transfer Facility Explosion) was revised to address the adequacy of the conductivity probes for the Tank 40/51 Valve Boxes. The equilibrium hydrogen concentration is less than 50% of the Lower Explosion Limit (LEL) (as shown in DSA Table 3.4-1) and a deflagration would result in approximately one tenth the consequences due to a detonation. Therefore, assuming a failure of the safety class first level of control (core pipe) to allow waste to accumulate in the valve box, the consequences of a deflagration in Tank 40/51 Valve Box during non-transfers would be a small fraction of the Evaluation Guidelines (see Calculation S-CLC-G-00209, Rev. 2) and the difference in consequences during a transfer would be minimal. The DSA concludes, and DOE agrees, that the conductivity probes provide an adequate second level of control similar to other valve box probes.

The ventilation modifications associated with the higher ventilation flow rate for Tanks 40 and 51 with ESP Sludge Slurry and to upgrade the ductwork due to cracking found during the structural integrity inspections will be implemented in two stages. A 0-2 inwc differential pressure gauge will be installed to replace the current 0-1 inwc gauge to account for the higher ventilation flow rate. Thus, TSR Revision 2004-C revised the required setpoint for these gauges in TSR Table 3.8.1-3 to the differential pressure which equates to 188 scfm and the instrument uncertainty calculations associated with these new gauges have been incorporated into the new setpoint. TSR Revisions 2005-A (Tank 40) and 2005-B (Tank 51) (submitted for approval via Reference 9) incorporate the required setpoint and associated uncertainty calculation for the ventilation system configuration following completion of all of the modifications (including new ductwork and flow elements). TSR Revisions 2005-A and 2005-B will then be included in the TSR upon implementation of the modifications in the facility.

DOE review of these revised and additional controls concluded that the controls are adequate to protect the worker, the public and the environment and the various sections of the DSA and TSR were appropriately revised to include these controls and their technical bases.

4.2 96H Valve Box

Building 241-96H is in the process of being converted from a filtration and benzene stripping facility (for the old in-tank precipitation process) to a facility where a Monosodium Titanite strike will be performed on material to be transferred to the Actinide Removal Process Facility (512-S) for

filtering. To support the transfers into and out of the 96H Facility, a new valve box is being built to house the jumpers connecting existing waste transfer lines. In accordance with the Safety Basis Strategy (Reference 4) approved by DOE (via Reference 5) and the Preliminary Functional Classification Report (Reference 6), the 96H valve box and associated transfer lines/jumpers will satisfy the safety related functions as described in Chapter 4 of the DSA. Appropriate references to the 96H valve box were provided throughout the DSA.

4.3 Unirradiated HEU Transfer from H-Canyon

A Low Level Waste Stream is being processed through the Tank Farm to Saltstone. A dedicated transfer path consisting of new equipment, jumpers, and above ground hose connected to existing transfer lines was designed and fabricated to support this transfer. The DSA Chapter 2, Revision 2 describes the transfer lines as typically constructed of stainless or carbon steel and normally below ground. It then describes the various types of transfer lines that exist within the tank farm. DSA Revision 3 provides an allowance for the transfer line to be of a different type (e.g., flexible hose) than those listed in the DSA for approved evolutions. In addition, the agitator from HPT-6 was relocated to HPT-5 (for storage only) to allow for placement of an inline transfer pump to move the material from HPT-6 to Tank 41 (and subsequently on to Tank 50). The description of the agitator in HPT-6 has been deleted in DSA Chapter 2, Revision 3.

4.4 Clarifications and Editorial Changes

The more significant clarifications and editorial changes are discussed below. The remaining changes are minor in nature and are not discussed in this SER supplement. The DOE review ensured that the changes did not result in any new hazards or new/deleted controls and that the changes did not invalidate the basis for acceptance of the DSA.

4.4.1 DSA Sections 3.4.2.8 and 5.5.4.2.37 were revised and a new condition was added to TSR LCO 3.7.5 (Transfer Facility Ventilation – Excluding HDB-8 Complex and HDB-7) to clarify the response time required to re-establish ventilation during jetted transfers into a Pump Tank. A jetted transfer into a pump tank will result in a higher hydrogen concentration in the pump tank vapor space due to release of dissolved hydrogen in the waste. The bounding response time (as determined in Calculation S-CLC-G-00209, Rev. 2) for recovery of pump tank ventilation is 21 minutes based on a full volume of waste in the pump tank. The Pump Tank Backup Ventilation System Program (TSR Administrative Control 5.8.2.37) requires a backup portable ventilation system with power be installed and functional for certain pump tanks which are receiving jetted transfers from a source greater than 1200 gallons. Figure 3.7.5-1 provides a graph depicting the recovery time as a function of pump tank waste volume. Condition B in LCO 3.7.5 provides the required actions and associated completion times for a low exhaust flow to a pump tank during a jetted transfer. Providing alternate ventilation system exhaust flow is required within the recovery times as depicted in the Figure 3.7.5-1. This response time has not changed as a result of this DSA/TSR revision, but the actions are more clearly depicted in the TSR for this condition. The condition, required actions and completion times associated with this scenario are considered adequate and appropriate.

4.4.2 DSA Section 3.4.2.5.3 was revised to clarify the different Material at Risk (MAR) used in the consequence calculations for the Transfer Facility Fire and the Evaporator Cell Fire. The DSA (Section 3.4.2.3) recognizes that bounding supernate may be transferred through the evaporator cell. However, for the vast majority of the facility operations, evaporator bottoms are the main hazard within the cell. Therefore, for the Evaporator Cell Fire, evaporator bottoms are the MAR. For the

Transfer Facility Fire, an HDB-8 Fire is bounding, which uses bounding sludge slurry for the MAR. This clarification is consistent with DOE understanding of the accident scenario and the basis upon which the DSA was initially approved.

4.4.3 In order to ensure that operation of waste tank mixing devices limits the planned release of trapped and dissolved hydrogen so as not to exceed the safety analysis value following a loss of ventilation, the Pump Run Program requires the vapor space hydrogen concentration to be less than or equal to the value assumed in the hydrogen release engineering evaluation. This was previously accomplished by one of two methods; a) a minimum of 12 vapor space turnovers, or b) verifying reading of an LFL monitor is less than or equal to the initial value assumed in the hydrogen release engineering evaluation. With incorporation of the Gas Release DSA package (HLW-CRF-04005) and TSR Revision 2004-A, both approved via DOE SER Rev. 0, Supplement 12, the methods were revised to; a) an adequate number of vapor space turnovers (per methodology specified in S-CLC-G-00283, with a mixing efficiency of 0.2), or b) by comparing the tank LFL reading to a reading obtained using a known LFL concentration (per methodology in WSMS-SAE-03-0123). By specifying a particular methodology and assumed mixing efficiency, a more consistent result can be obtained. The DSA and TSR revisions submitted in Reference 1 allow either method a or b or a combination of a and b for verifying the vapor space concentration. This revision is considered adequate and protective of the intended safety function.

4.4.4 With incorporation of the Gas Release DSA package (HLW-CRF-04005) and TSR Revision 2004-A, both approved via DOE SER Rev. 0, Supplement 12, the DSA no longer credits the requirement to manually secure slurry pumps/mixing devices via manual disconnects upon low ventilation flow or high hydrogen concentration. For tanks that exceed the gas release criteria specified in DSA Section 3.4.2.11, continuous waste tank ventilation with local flow indications, low flow interlocks (to stop mixing devices), and low flow control room alarms are required. The Flammability Control Program determines the hydrogen concentration limit (not to exceed 60%). The Pump Run Program controls operation of the mixing devices to limit planned release of trapped gas. Continuous hydrogen monitoring with a high hydrogen concentration interlock (to stop mixing devices) and a control room alarm for high hydrogen concentration and low analyzer sample flow are required. The waste tank structure provides a mitigative capability as an additional level of control. Therefore, the elimination of this operator action to secure the slurry pumps via manual disconnects is appropriate.

4.4.5 In order to distinguish between salt dissolution activities that have the potential to release a significant amount of hydrogen and those that do not, a new defined term "Bulk Salt Dissolution" has been developed and included in the DSA and TSR. It is not necessary to apply the controls associated with salt dissolution and hydrogen release to minor activities (such as those listed below) that will not result in a release of hydrogen that could cause the vapor space to exceed the safety analysis limit. Those minor activities not included in this defined term include:

- Transfer into a salt tank with small exposed salt peaks (height and base in inches not feet)/exposed salt on cooling coils
- Flushing of equipment in a salt tank
- Sample rinsing
- Filling purge condenser seal leg
- Routine evaporator operation

This definition is considered adequate for ensuring the appropriate activities are evaluated for potential release of significant quantities of hydrogen.

4.4.6 Where Chromate Cooling Water header isolation valves are credited to mitigate a release of radioactive material by providing a means of stopping a siphon or pump-out of the waste tanks, an allowance is given for "minor leak-by". This is defined in the DSA as not more than a trickle (i.e., a thin stream or drop). This is judged as sufficiently small such that the ability to stop a siphon or pump-out and mitigate a release to the environment can still be satisfied.

4.4.7 Each of the Design Basis Accidents in Section 3.4.2 of the DSA was reviewed by WSRC to ensure that for each of the accident scenarios, a sufficient number of Levels of Control (LOCs) have been identified in accordance with WSRC Manual E7, Procedure 2.25, Revision 13 (code of record for DSA Revision 0). This review resulted in the identification of existing controls for several specific scenarios in the Tornado/High Wind Event (DSA Section 3.4.2.17), Seismic Event (DSA Section 3.4.2.18), Wildland Fire Event (DSA Section 3.4.2.19), and Loss of Offsite Power (DSA Section 3.4.2.20) that did not specifically identify the LOCs. There were no new controls added to the DSA as a result of this review. However, there were some existing controls that were not credited for specific scenarios that are now appropriately listed and referenced in the DSA accident discussions and tables of credited controls.

4.5 Resolution of DOE SER Revision Issues

There are 4 outstanding DOE SER Revision Issues associated with the CSTF SER Revision 0 (Reference 3) and its supplements. Each of them is summarized below:

- Revision Issue CSTF-0-13-R1 noted some inconsistencies between the text in DSA Chapter 4 and a corresponding table also within Chapter 4. DSA Revision 3 (Annual Update) adequately corrected these inconsistencies.
- Revision Issue CSTF-0-12-R1 stated that the results/conclusions in CBU-LTS-2004-00086 need to be captured in the basis for acceptability of the Gas Release Mode. DSA Revision 3 appropriately added this report as a reference.
- Revision Issue CSTF-0-12-R2 stated that the results/conclusions in CBU-LTS-2004-00087 and SRNL-LWP-2004-00022 need to be captured in the basis for acceptability of the Gas Release Mode. DSA Revision 3 appropriately added these reports as references.
- Revision Issue CSTF-0-9-R1 states that prior to placing another tank into Removed From Service Mode after Tank 18, the DSA and TSR Mode definition should be revised to reflect the preferred method of tank transfer system isolation being blanks or cutting/capping. This issue was not resolved in DSA Revision 3 or TSR Revisions 2004-C, 2005-A, or 2005-B due to a conflict with the plan and schedule for isolation of the tanks that will been removed from service. This issue will remain open but will be resolved prior to placing the next waste tank in the Removed From Service Mode.

4.6 Work Scope

The proposed DSA/TSR changes do not add any new work scope to the existing CSTF authorized and planned activities nor do they introduce any new hazards to the facility. The most significant changes not previously reviewed by DOE involve sludge processing which is already described and authorized in the DSA. The proposed changes do not invalidate any premise upon which DOE

initially approved the Documented Safety Analysis and Technical Safety Requirements in December 2002.

4.7 USQE Report

The Annual USQE Report for the period of November 2003 through November 2004 was also submitted as Attachment 2 to Reference 1. These evaluations were reviewed to ensure the proposed activities were clearly defined and evaluated against the DSA assumptions and requirements, sufficient information was included in the USQE to conclude the hazards associated with the proposed activities were thoroughly evaluated and documented, and the appropriate conclusion, including the need for DOE approval, was reached.

A sampling of the evaluations listed in the attachment was reviewed by DOE and found to provide adequate justification and appropriate conclusions that the activity did not involve a USQ. One of the USQ Evaluations resulted in a USQ, that being U-USQ-G-00056, Rev. 0, "Sludge Hydrogen Retention PISA Evaluation". The subject PISA (PI-04-003) was declared because, contrary to the DSA in effect at the time, > 50% of hydrogen generated can be retained below the top 40 inches of sludge and the top 40 inches of sludge can retain hydrogen. The Discovery USQ and associated DSA changes (HLW-CRF-04002) were evaluated in DOE SER Rev. 0 Supplement 10 (Reference 6), and were properly incorporated into DSA Revision 3.

USQ-WPT-2004-00311, Rev. 0 evaluated PISA (PI-04-004), which was declared due to new information from the vendor of the Det-Tronics CLFL Monitor for Tank 48. The information potentially affected the instrument uncertainty which could impact the TSR Composite Lower Flammability Limit (CLFL). A Response Plan (RP-HTF-04-001) was issued by WSRC and approved by DOE via SER Rev. 0, Supplement 11 (Reference 7) to provide necessary compensatory measures and justification to maintain Tank 48 in a safe condition until the CLFL Analyzer could be restored to compliance. It was subsequently determined that the vendor information was misapplied and the TSR limit was not impacted. Therefore, this did not result in a USQ. The Response Plan was then exited. No changes to the DSA or TSR resulted from this activity.

Several of the USQ Evaluations are associated with changes that have been incorporated into this DSA/TSR Revision. The associated DSA/TSR change is referenced in the USQE Attachment to Reference 1. The following sampling of non-USQ Evaluations that did not result in a DSA/TSR change was reviewed and found to provide adequate justifications and appropriate conclusions:

- USQ-HTF-2004-00549, Rev. 0 - Air Purge and Flushing the 242-25H Evaporator Warming Coil
- TRC-WPT-2004-00504, Rev. 0 - 241-96H Valve Box and Conductivity Probe Installation for the Actinide Removal Process
- TRC-HTF-2003-00622, Rev. 0 – HDB-8 Process Vessel Ventilation Flow Measuring Loop Uncertainty Evaluation

5.0 Conditions of Approval

None.

6.0 Conclusions

Based on the evaluation documented in Section 4.0 of this SER supplement, DOE review of the safety basis changes concludes no new hazards were introduced and the appropriate controls have been applied to protect the onsite workers, the general public, and the environment. DOE found the changes to satisfy the applicable review criteria used from the safe harbor in 10CFR830, Subpart B, that being DOE-STD-3009 and DOE Guide G423.1-1. Additionally, the proposed changes did not invalidate any premise upon which DOE approved DSA/TSR Revision 0 or any subsequent supplements. Therefore, the proposed CSTF DSA and TSR changes submitted in References 1, 2 and 9 are approved.

7.0 References

1. Letter, Olson to Hansen, "Submittal of the 2004 Concentration, Storage, and Transfer Facilities (CSTF) Annual Update and Unreviewed Safety Question (USQ) Annual Report," CBU-LWD-2004-00114, 12/17/2004.
2. Letter, Olson to Hansen, "Submittal of Page Changes for Technical Safety Requirement Revision 2004-C (U)," CBU-LWD-2005-00021, 01/21/05
3. Letter, Allison to Pedde, "DOE CSTF SER Rev. 0," PC-03-008, 12/20/2002
4. WSRC-TR-2003-00487, Rev. 1, "Safety Basis Strategy for 241-96H Actinide Removal Process," 12/03.
5. Letter, Hansen to Olson, "Safety Basis Strategy for the 241-96H Actinide Removal Process," DC-04-023, 3/9/04.
6. Letter, Allison to Pedde, "Submittal of the 2003 Concentration, Storage, and Transfer Facilities (CSTF) Annual Update and Unreviewed Safety Question (USQ) Annual Report, and Hydrogen Retention in Sludge Tanks Documented Safety Analysis (DSA) Revision," DC-04-022, 3/5/04.
7. Letter, Allison to Pedde, "Submittal of the Tank 48 CLFL Analyzer Potential Inadequacy in Safety Analysis and Associated Response Plan (Letter, Olson to Hansen, 06/04/04)," DC-04-037, 6/4/04.
8. Letter, Olson to Hansen, "Request to Delay Approval of the Concentration, Storage, and Transfer Facilities (CSTF) Annual Update (U)," CBU-LWD-2005-00023, 2/10/05.
9. Letter, Olson to Hansen, "Submittal of Page Changes for Technical Safety Requirements Revision 2004-C and Revisions 2005-A and 2005-B (U)," CBU-LWD-2005-00024, 2/25/05.