DOE-SR Mail Control
Cover Sheet
*** Incoming Mail ***

ACTION

US DOE Savannah River Operations Office Mail Control Form SR-59

November 20, 2015

Document Number:	151109	Correspondence Type:	Letter
Critical Designation:	Routine	Copy Type:	Email
Addressee:	CMD 522N310000	Originator:	Jeffrey J. Bair
Subject:	Contract DE-AC09-09SR225055 - Request for Concurrence - Defense Waste Processing Facility (DWPF) Safety Basis Strategy of Alternate Reductant; and Request for Approval - Revision to DWPF Evaluation of the Safety of the Situation for PISAs PI-2014-0009 and PI-2014-0013; SRR-CAA-2015-00405 (Letter, Bair to Smith)	Originating Org.:	SRR
		Date Received:	11/20/2015
		Document Date:	11/19/2015
		Classification:	Unclassified
		Assigned To:	WDED 522F200000
		Compliance Date:	
Manager Signature Required:	Yes	Suspense Date:	12/9/2015
Remarks:	DOE Lead: Tom Temple. SRS is requesting Contracting Officer concurrence and approval by December 11, 2015.	Distribution:	WDED, AMWD, OAM, Charlene Smith, DM, MGR

If This Document is Incorrectly Assigned PLEASE Return Immediately to DOE Mail Control or Forward to the Correct Office and Notify DOE Mail Control

151109

Savannah River Remediation
AECOM | BECHTEL | CH2M | B&W | AREVA

NOV 2 0 2015

SRR-CAA-2015-00405
RSM Tracking No. 10667

Ms. Charlene Smith, Contracting Officer
U.S. Department of Energy
Savannah River Operations Office
Post Office Box A
Aiken, South Carolina 29802

Dear Ms. Smith:

CONTRACT DE-AC09-09SR22505 – REQUEST FOR CONCURRENCE – DEFENSE WASTE PROCESSING FACILITY (DWPF) SAFETY BASIS STRATEGY IN SUPPORT OF ALTERNATE REDUCTANT; AND REQUEST FOR APPROVAL – REVISION TO DWPF EVALUATIONS OF THE SAFETY OF THE SITUATION FOR PISAS PI-2014-0009 AND PI-2014-0013

Ref: Contract DE-AC09-09SR22505, Section J, Appendix M, Contract Deliverable 7, Safety Basis Documents; and Section C.2.3, Development and Maintenance of Safety Documentation

Pursuant to the Reference, Savannah River Remediation LLC (SRR) requests Department of Energy (DOE) Contracting Officer concurrence of Safety Basis Strategy (SBS), U-SBS-S-00003, Rev. 1 (Attachment 1), and approval of Evaluation of the Safety of the Situations (ESS), U-ESS-S-00001, Rev. 1 (PI-2014-0009, Melter Feed Rate) (Attachment 2) and U-ESS-S-00002, Rev. 1 (PI-2014-0013, Retained Hydrogen) (Attachment 3). This Safety Basis Strategy addresses the safety basis considerations for Alternate Reductant as well as the resolution of three Potential Inadequacies in the Safety Analysis (PI-2014-0009, PI-2014-0013, and PI-2015-0009 (Antifoam)). The ESS revisions establish new dates for incorporation (and subsequent implementation) of the necessary controls into the safety basis documents. Attachment 4 is the associated SRR Safety Document Approval Form.

NOV 2 0 2015

SRR reviewed the DWPF Authorization Agreement (AA), and no changes are required for this submittal.

SRR is requesting Contracting Officer concurrence and approval by December 11, 2015. The SBS as well as the changes to the ESS documents have been reviewed with Mrs. Pauline Hang and Mr. Tom Temple of Waste Disposition Engineering Division.

If you have any questions concerning this request, please contact Mr. Thomas Huff at 208-2418, or me at 208-2845.

Sincerely,

Louie P. Alves Sr. for

Jeffrey J. Bair, Manager
Contract Management & Administration

JJB/wac

Attachments:
1. U-SBS-S-00003, Rev. 1
2. U-ESS-S-00001, Rev. 1
3. U-ESS-S-00002, Rev. 1
4. SRR Safety Basis Document Approval Form

NOV 2 0 2015

cc: J. R. Craig, DOE-SR, 730-B
J. L. Folk, 704-S
P. Giles, 704-S
P. N. Hang, 704-S
C. T. Hughes, 730-B
J. D. Lipsky, 730-B
J. M. Ridley, 704-S
S. J. Robinson, 730-B
M. A. Smith, 704-S
T. C. Temple, 704-S
DOE-SR ECATS, 730-B
S. A. MacVean, SRR, 766-H
M. A. Schmitz, 766-H
W. M. Barnes, 704-S
G. G. Campbell, 766-H
T. E. Colleran, 766-H
R. E. Edwards, 766-H
S. P. Fairchild, 766-H
J. K. Fortenberry. 766-H
V. A. Franklin, 705-1C
E. J. Freed, 704-S
K. A. Hauer, 766-H
T. H. Huff, 766-H
J. D. Humphrey, 766-H
W. A. Condon, 766-H
O. D. Stevens, 766-H
J. D. Townsend, 766-H
G. J. Matis, 704-S
L. T. Ling, 766-H
J. R Gregory, 704-S
L. T. Blackford, 704-56H
J. S. Contardi, 704-56H
C. D. Cope, 766-H
C. R. Whitehurst, 707-13E
J. E. Owen, 704-30S
Records Administration, 773-52A

To: Louie Alves/SRR/Srs,
Cc:
Bcc:
Subject: Temporary Delegation of Authority

I hereby delegate to Lou Alves authority to act on my behalf, which includes the signing of letters, for Friday, November 20, 2015.

Jeffrey J. Bair
Manager, Prime Contract Administration
Savannah River Remediation
Contractor to
US Department of Energy
(803) 208-2845
(803) 215-3394
jeffrey.bair@srs.gov

ATTACHMENT 1

U-SBS-S-00003, Rev. 1

Safety Basis Strategy

Defense Waste Processing Facility Alternate Reductant Project

U-SBS-S-00003

November 2015

Prepared By:	**E. M. Riddick** **Nuclear Safety**	**Signature**	11/10/15 **Date**
Reviewed By:	**J. D. Townsend** **Nuclear Safety**	**Signature**	11/10/15 **Date**
	A. T. Clare **DWPF Engineering**	**Signature**	11/10/15 **Date**
	A. V. Staub **Design Authority**	**Signature**	11/10/15 **Date**
Approved By:	**T. H. Huff** **SBRA,** **Nuclear Safety Manager**	**Signature**	11-12-15 **Date**
	E. J. Freed **DWPF Engineering Manager**	**Signature**	11-12-15 **Date**
	W. M. Barnes **DWPF Facility Manager**	**Signature**	11/12/15 **Date**
	T. E. Colleran **Project Engineering Manager**	**Signature**	11/10/2015 **Date**
	W. O. Pepper **Project Manager**	**Signature**	11/12/2015 **Date**

1.0 Purpose

This Safety Basis Strategy (SBS) document addresses the safety basis considerations for the Alternate Reductant Project as well as the resolution of three Defense Waste Processing Facility (DWPF) Potential Inadequacies in the Safety Analysis (PISAs). The three PISAs include the Melter Feed Rate (PI-2014-0009), Retained Hydrogen (PI-2014-0013), and Antifoam Degradation Products (PI-2015-0009). Outside of the work performed regarding the three PISAs, all activities to date have been limited to those activities deemed necessary to implement the Alternate Reductant Project.

The purpose of the SBS is to provide a common understanding of the management expectations, scope, roles and responsibilities, strategy and methods to be used for Alternate Reductant Project safety basis considerations incorporated with the final resolution of the aforementioned PISAs. The SBS is prepared in accordance with Manual 11Q, Procedure 1.10, Safety Basis Strategy (Ref. 1).

2.0 Description of Project

The Nitric-Formic Acid-based flowsheet process is currently used at the U.S. Department of Energy (DOE) Savannah River Site (SRS), for preparing feed for the DWPF melter. The process is the original design and has operated since 1996. Inherent in this flowsheet, catalytic hydrogen is generated from the interaction of formic acid and trace quantities of noble metals creating a continual flammability control requirement for the Chemical Process Cell (CPC) while the decomposition of formate (from the CPC) in the Melter also requires continual flammability controls. The CPC in the DWPF prepares feed for the DWPF melter. The key chemical steps in the process are concentration of the raw radioactive waste, complete neutralization reactions, reduction and removal of mercury with formic acid, and adjustment of the reduction-oxidation (REDOX) state of the melter feed to within the acceptable range. Late in the DWPF process development, it was discovered that the Nitric-Formic Acid process would produce catalytic hydrogen in sufficient quantities to create a flammable gas concern in the CPC.

The Nitric-Formic Acid process required, prior to facility start-up in 1996, extensive modifications to the process ventilation systems to dilute catalytic hydrogen produced from formic acid in the presence of noble metals (rhodium, ruthenium, palladium, and silver). In addition to the increased purge required, gas chromatographs (GCs) were required to monitor hydrogen and ensure that flammability control was maintained.

The Alternate Reductant Project was initiated by Savannah River Remediation (SRR) to explore options for the replacement of the nitric-formic flowsheet used for the CPC at DWPF. The primary goal of the Alternate Reductant Project is to reduce operational hazards. The Alternate Reductant Project will replace formic acid in the CPC with ~70 wt.% glycolic acid and sufficient nitric acid for initial neutralization of the sludge feed, reduction of mercury, and to ensure melter REDOX (Fe^{II}/Fe^{tot}) is between 0.09 and 0.33 (existing range). The replacement of formic acid with glycolic acid will significantly reduce catalytic hydrogen generation in the CPC. Glycolic acid's role in the CPC will be sufficiently similar to that of formic acid that physical modifications will be minimal. The primary benefit resulting from the usage of glycolic acid is the substantial reduction in catalytic hydrogen generation. Some additional benefits from

glycolic acid and reduced catalytic hydrogen include: potential reduction of the process vessel purge, potential downgrading of the functional classification or elimination of the GCs, more favorable rheology potentially allowing more concentrated feed to the Melter, less surge of non-condensable gases from the Melter cold cap, less foaming and a more favorable flammability control envelope for both the Melter and the CPC.

Three PISAs have recently been identified at DWPF: Melter Feed Rate Temperature Correlation Basis, Retained Hydrogen in the Vessels, and Impact of Antifoam Degradation on Flammability. The Melter Feed Rate PISA exists with the use of bubblers in the Melter. The current flammability model is based on a Melter feed rate which is indirectly protected by a low melter vapor space temperature interlock. The basis for this interlock setpoint is a heat model that was performed by Savannah River National Laboratory using assumptions that were validated before the installation of the Melter bubblers but have been determined to be non-conservative under bubbled operations. The second PISA is from the retention of hydrogen (due to lack of agitation) in DWPF vessels that contain sludge not being adequately addressed or accounted for in the DWPF safety analysis. The third PISA relates to the degradation of Antifoam used in DWPF processing to produce organic components that are not currently evaluated in the DWPF CPC vessel flammability analysis. Currently, the PISAs are addressed by compensatory measures given in the Evaluation of the Safety of the Situation (ESS) or Justification of Continued Operations (JCO). The benefits from using glycolic acid in the DWPF process are anticipated to aid in the final resolution of the PISAs as they are related to flammability concerns in the facility. Specifically the reduction in catalytic hydrogen generation is expected to provide more than sufficient margin in order to account for the additional flammables that may be present in the facility processing.

It is important to note that this project is expected to involve limited physical design changes and is primarily a chemical process change.

3.0 Roles/Responsibilities

Design Authority (DA) is responsible for:

- Approving the SBS,
- Performing technical reviews and approval of the safety analysis and documents covered by this SBS,
- Providing technical inputs, participating in development, and overseeing the technical content of the documentation associated with the SBS, and
- Ensuring appropriate technical agencies are involved.

Project Manager is responsible for:

- The direction/scope of the activities covered by this SBS,
- Providing support to the Safety Basis Regulatory Authority (SBRA) in preparing the SBS,
- Defining facility/project boundaries,
- Providing support to the SBRA in defining process inputs and assumptions, and
- Providing support to the SBRA in defining project/schedule milestones

The DWPF Engineering Manager, or designee, is responsible for:

- Acting as the Design Agency representative,
- Management and review of facility inputs and assumptions for calculations and other documents that support the safety analysis required by the scope of this SBS, and
- Approving the SBS.

SBRA, or designee, is responsible for:

- Preparing the SBS and
- Ensuring the SBS gets the appropriate reviews and approvals

DWPF Facility Manager is responsible for:

- Providing the required knowledgeable resources to support the scheduled activities covered by this SBS and
- Providing review and responses to support the scheduled activities covered by this SBS.

4.0 SBS Overview

4.1. Goals and Objectives

The objective of this SBS is to define the safety basis strategy for Alternate Reductant Project implementation along with the resolution of the three DWPF PISAs. Three safety basis changes will be submitted to DOE in order to complete all project items and are given below:

1. The first safety basis change will occur as part of the 2016 Annual Update and will incorporate the compensatory measures currently in place from the ESSs and JCO for the PISAs. There is the potential for changes to these controls, particularly for the Melter flammability, depending on the resolution progression. The compensatory measures incorporated in the 2016 Annual Update are not expected to support a return to full operating processing rates and waste compositions.

2. The second, or Interim, safety basis change will allow for the use of formic, glycolic, or a combination of the two acids during processing under the current controls (see Assumption 1 in Section 5.2), including the compensatory measures incorporated in "1" above. This allows for a transition from formic acid to glycolic acid in DWPF.

3. The third, or Final, safety basis change will account for the use of glycolic acid and the elimination of formic acid in processing. This safety basis change will make the necessary changes to return to full operating processing rates and waste compositions.

To begin the safety basis changes, Consolidated Hazard Analyses (CHAs) will be conducted per SCD-11 (Ref. 2). The CHA teams will identify the hazards associated with Alternate Reductant Project Implementation activities and the PISA resolutions and the associated controls required to address the hazards. The existing CHAs for DWPF will be used as a basis and revised to include changes from the Alternate Reductant Project and the PISA resolutions, as appropriate. If necessary, new CHA documents will be developed.

The first submittal (2016 Annual Update) may require additional analysis to support the controls from the ESS/JCO. For the Final safety basis change, several supporting calculations will be revised or developed for the purge analysis and consequence analysis. The consequence analysis will be revised to include new methodology for the dispersion data as described in Reference 13. The new methodology includes usage of the DOE-STD-1189 χ/Q value for the onsite receptor as well as a new χ/Q value for the offsite receptor based on 95th percentile meteorological data and 160-cm surface roughness (Ref. 13 and 14). The NPH consequences will not be updated for the new methodology as part of this project. The NPH consequences will be updated as part of updating the total effective dose factors for all of Liquid Waste consistent with Reference 13. Changes to the DWPF facility and any required controls identified in the CHAs will be documented in a change to the DWPF Final Safety Analysis Report (FSAR) and/or Technical Safety Requirement (TSR). The Concentration, Storage, and Transfer Facilities (CSTF) and Saltstone Facility may each require a CHA to address glycolate in the recycle stream. However, the only projected change is the addition of glycolate to the Waste Acceptance Criteria (WAC).

4.2. Schedule and Milestones

Activities for the Alternate Reductant Project and PISA resolutions will be tracked in the project schedule. The schedule is built to show submittal and implementation of the 2016 Annual Update (first safety basis change) by August 2016 and January 2017, respectively. The Interim and Final safety basis changes are anticipated to be submitted by November 2016. Once the Interim safety basis package is implemented with formic and glycolic acids in the system and several batches have been processed to reasonably remove formic acid from the system, it is expected that the Final safety basis package will be implemented shortly thereafter. The schedule includes logic for activities necessary to determine potential control revisions including supporting vessel purge and consequence calculation revisions.

Any changes or additions to the activities will be handled through the project schedule and may require revision of the SBS. A change control process will be used to manage scope changes. Addition of new scope, significant changes to the existing scope, strategy, or assumptions outlined in this document including schedule changes will be documented, reviewed, and authorized by the Alternate Reductant Project Manager and the DWPF Engineering Manager, or designee. The need to revise this SBS will be at the discretion of the DWPF Engineering Manager.

5.0 SBS Approach

5.1. Hazard Review and Controls Identification

The CHAs will be facilitated by a trained Consolidated Hazard Analysis Process (CHAP) Lead using an integrated team approach employing the appropriate hazard evaluation method. The CHA will be performed in accordance with DOE-STD-3009-94 (Ref. 7) following the methods outlined in SCD-11 (Ref. 2). Functional classification in the CHAPs to support the 2016 Annual Update and Interim safety basis change will follow the Code of Record used by the current safety basis while the Final safety basis change will be based on the current revision of Manual E7, Procedure 2.25A (Ref. 6) for the changes driven by the Project. The CHAP will include hazard identification, facility hazard categorization, screening of common industrial hazards,

unmitigated and mitigated Hazard Analysis (HA), functional classification of Structures, Systems or Components (SSCs), and programs employed as controls for the associated hazards.

5.1.1. Hazard Categorization

The primary purpose of the Facility Hazard Categorization activity is to identify hazardous material inventories and to establish the facility Hazard Category (HC) per DOE-STD-1027-92 (Ref. 4) so that appropriate safety documentation can be prepared. Alternate Reductant Project and PISA resolution changes will primarily take place in the DWPF CPC and Melter and potentially affect downstream activities. The DWPF CPC and Melter are in a HC-2 segment of the DWPF facility. In addition to the impacts to the Vitrification building and downstream processes, the glycolic acid will be stored in the Cold Chemical Feed Storage Facility (422-S). These changes made in the Cold Chemical Feed Storage Facility will not challenge its hazard categorization of HC-3. Alternate Reductant Project and PISA resolution activities will not alter the Hazard Category or attempt to further segment the DWPF. The project is not expected to impact downstream HCs.

5.1.2. Controls Identification

This SBS is based on the assumption that the current formic acid flowsheet controls are bounding for the glycolic acid flowsheet. Therefore, there is no need for an intermediate set of Alternate Reductant controls with the exception of a potential change to the Melter Feed Contents control. (See Section 5.2 Assumption 1) Additionally, the PISA closure process is expected to incorporate the current compensatory measures into the 2016 Annual Update. The control set for the Final submittal is expected to be consistent with the set presented to Sr. SIRC (Attachment B) with potential changes for the Antifoam Degradation PISA resolution. The following controls are identified as having a high potential for revision or removal. As the formal CHA process has not been completed, this list may not be all inclusive.

1. DWPF LCO 3.1.1 CPC Flammability Monitoring – The GCs are currently required to be operable per LCO 3.1.1. The operation will potentially no longer be required and the hydrogen concentration will be shown to be acceptable via calculation without the possibility of exceeding limits. This would be a potential opportunity for a reduction in controls. The GCs may no longer be needed.
2. DWPF LCO 3.1.3, 3.1.4, 3.1.5, 3.4.3 Purge Flows – Reduced catalytic hydrogen generation and potential inclusion of additional flammables may require changes to the purge flows. The lower hydrogen generation rate (HGR) is a result of the removal of formic acid from the process. Surveillance Requirements (SRs) would similarly change.
3. DWPF LCO 3.1.6, 3.4.5 Purge Source –Changes to the purge flows will result in changes to the nitrogen inventory requirement. This would result in changes to LCO Conditions and SRs.
4. DWPF LCO 3.1.8 Melter Feed Contents – Using glycolic acid instead of formic acid and the resolution of the Antifoam Degradation PISA may impact the assumptions of the calculation for Melter flammability control. In addition, the resolution of the Melter Feed Rate PISA may result in the change of this LCO to a programmatic control.

5. DWPF LCO 3.3.1 Melter Off-Gas Flammability Control – Changes to the calculation for Melter Off-Gas flammability control may result in changes to this LCO. The results from the Melter Feed Rate PISA may change this LCO to a programmatic control.
6. CSTF SAC 5.8.2.15 WAC – Addition of glycolate limit to the CSTF (and possibly Saltstone) WAC.
7. DWPF SAC 5.8.2.11 WAC – A more restrictive Inhalation Dose Potential (IDP) limit will be implemented in the 2016 Annual Update in support of the ESS and JCO incorporation.
8. DWPF LCO 3.7.1 Zone 1 Ventilation – As part of the 2016 Annual Update submittal for incorporation of the ESS and JCO compensatory measures, the Zone 1 Ventilation System will become a 1st Level of Control (LOC) to mitigate the consequences from vessel explosions in the Vitrification Building. The advantage of employing a robust, engineered system as a 1st LOC is deemed preferable to a 1st LOC that is solely dependent on models and administrative programs. However, the control strategy for vessel explosions will utilize both controls. To support Zone 1 Ventilation as a 1st LOC, LCO 3.7.1 requires the operability of three Zone 1 Exhaust Fans. This operability requirement is already reflected in the TSRs to support the JCO and will be incorporated directly into the FSAR in the 2016 Annual Update. As part of the Final safety basis changes, it is expected for the Zone 1 Ventilation System to remain the 1st LOC and with a potential to be upgraded via backfit analysis from Safety Significant to Safety Class.
9. DWPF LCO 3.9.1 Standby Electrical Power - To support Zone 1 Ventilation as a 1st LOC, the LCO 3.9.1 requires the operability of both diesel generators at all times versus a single diesel as previously required. In addition, both air receiver pressure indicators must be operable, and the lube oil storage tanks must have an inventory of at least 25%. These operability requirements are already reflected in the current TSRs to support the JCO and will be incorporated directly into the FSAR in the 2016 Annual Update. As part of the Final safety basis changes, it is expected for LCO 3.9.1 to remain a 1st LOC and with a potential to be upgraded via backfit analysis from Safety Significant to Safety Class.
10. DWPF Administrative Control (Required by Retained Hydrogen ESS) – In order to protect DWPF vessels from flammable conditions due to the release of retained hydrogen, a quiescent time (or q-time) program will be implemented. The program allows for up to 13 days of non-agitation in DWPF CPC vessels before deliberate actions must be taken to prevent a potentially significant release of hydrogen from the waste, mainly restoring agitation. Other actions may include extending the q-time with additional engineering evaluation or managing the vessel vapor space with diffusion of the flammable gases into the CPC vapor space. The 13-day q-time bounds all conditions in the CPC vessels when processing Sludge Batch 8 (and Sludge Batch 9, assuming it is found to not be significantly different), including catalytic hydrogen generation conditions (Ref. 16). Currently for Low Point Pump Pit vessels, minimum q-times are 10 and 7 days for the SPT and RPT, respectively, per Reference 17.

5.2. Process Inputs and Assumptions

The inputs and assumptions necessary to support the decisions made by the CHAP team will be documented in the CHAs. These will be validated as the project matures. Prior to issuance of the final CHAs, the final design will be reviewed to ensure the CHA inputs and assumptions are accurate.

The inputs and assumptions for this SBS include:

1. As part of the Interim safety basis change, the formic acid flowsheet controls are assumed to bound the glycolic acid flowsheet and no new intermediate control set will be required. This assumption is based on the formic acid controls remaining in place until heels containing formic acid are worked off and a transition to glycolic controls can be made. This assumption is reasonable as testing has shown low hydrogen generation from the glycolic acid flowsheet (Ref. 9). The current calculations determining the purge flows will be reviewed to ensure that the formic controls will be bounding. Additionally, testing to date has shown the surges of non-condensable gases from the Melter cold cap are less than the surges under Formic Acid during bubbled operations (Ref. 15). The Melter Feed Contents LCO will potentially need intermediate revision to allow for the presence of glycolic or formic acid.
2. Formic acid is an impurity generally present in glycolic acid. This is due to the presence of formic acid in the production process. It is assumed that this quantity is negligible and poses no threat to the facility. This is based on testing performed to date which shows that the formic acid concentration in the glycolic acid is negligible (Ref. 9).
3. It is assumed that downstream impacts to other facilities will be limited to potential CSTF and Saltstone WAC revisions. This assumption is based on testing which shows no adverse impact to the downstream facilities from the Alternate Reductant Project (Refs. 10, 11, 12).
4. As part of the Final safety basis change, the supporting calculations will need to be revised. Purge analysis will be revised to account for changes in the potential flammables, e.g., lower catalytic hydrogen generation rate, amount of organic antifoam degradation products present, etc. The consequence analysis will also be revised for any changes in the potential flammables as well as updates to the dispersion methodology per Reference 13 (for onsite and offsite receptors). As previously mentioned in Section 4.1, the cumulative NPH consequences will not be updated as part of this project, but will be updated as part of updating the total effective dose factors for all of Liquid Waste consistent with Reference 13. In addition, there is the potential to redefine the current vessel explosion scenario in which one vessel explosion in the CPC propagates to all the vessels causing them to explode as well.
5. Chemical consequence analysis will be performed as necessary for the introduction of glycolic acid into the DWPF process. However, no additional controls are anticipated for chemical consequences.
6. Waste stream composition changes as a result of the Salt Waste Processing Facility (SWPF) will be considered in relation to the final control selection for the Alternate

Reductant Project and PISA resolutions. Although SWPF is not scheduled to begin operation until after alternate reductant has been introduced into the facility, during the CHAP discussions for this Project, the consequences of the higher waste streams will be considered.

5.3. Documentation and Analysis

Changes to the existing DWPF FSAR/TSR and CSTF/Saltstone safety basis changes will be developed to incorporate the description, analyses, and controls, as applicable. The FSAR/TSR and any other safety basis changes will be produced in accordance with Manual 11Q, Procedure 1.01, Generation, Revision, Review, and Approval of SB Documents (Ref. 5), and supporting procedures. Several controls will likely require revisions as indicated in Section 5.1.2.

A Major Modification Evaluation (see Attachment A) was performed and concluded that the Alternate Reductant Project is not a Major Modification. Therefore, no Preliminary Documented Safety Analysis (PDSA) will be required.

The Alternate Reductant Project and PISA resolutions may require descriptive text changes to the criticality and fire protection analysis of DWPF. It is anticipated that the changes for the Alternate Reductant Project and PISAs will impact the DWPF Emergency Preparedness Hazards Assessment (EPHA) and possibly the criticality analysis of the 2H evaporator system. It is not expected the changes will require additional controls. Revisions to criticality evaluations will be in accordance with SCD-3 (Ref. 8). No major safety basis impacts are anticipated for Saltstone.

6.0 References

1. Manual 11Q, Procedure 1.10, Revision 5, Safety Basis Strategy.
2. SCD-11, Revision 12, Consolidated Hazard Analysis Process (CHAP) Program & Methods Manual.
3. Deleted.
4. DOE-STD-1027-92, Change Notice 1, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.
5. Manual 11Q, Procedure 1.01, Revision 19, Generation, Revision, Review, and Approval of SB Documents.
6. Manual E7, Conduct of Engineering and Technical Support, Procedure, 2.25A, Rev. 0.
7. DOE-STD-3009-94, Change Notice 3, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analysis.
8. SCD-3, Revision 28, Nuclear Criticality Safety Manual.
9. SRNL-STI-2013-00343, Revision 0, FY13 Glycolic-Nitric Acid Flowsheet Demonstrations of the DWPF Chemical Process Cell with Simulants.
10. SRNL-STI-2013-00322, Revision 0, Actual Waste Testing of Glycolate Impacts on the SRS Tank Farm.

11. SRNL-STI-2013-00166, Revision 0, Simulated Waste Testing of Glycolate Impacts on the 2H Evaporator System.
12. SRNL-STI-2012-00218, Revision 1, Determination of the Impact of Glycolate on ARP and MCU Operations.
13. U-SBS-G-00002, Revision 0, Safety Basis Strategy Updated Total Effective Dose Factors.
14. S-ESR-G-00033, Revision 0, Dispersion Modeling Project Implementation.
15. SRNL-STI-2014-00355, Revision 0, DWPF Melter Off-Gas Flammability Model for the Nitric-Glycolic Acid Flowsheet.
16. X-ESR-S-00264, Revision 0, Input in Response to Defense Nuclear Facilities Safety Board Letter on Defense Waste Processing Facility Safety Basis.
17. X-CLC-S-00329, Revision 0, Quiescent Times for the Recycle Pump Tank and Sludge Pump Tank.

Attachment A:

OSR 19-349 (Rev. 12-16-2009)

Major Modification Evaluation

Criterion No.	Evaluation Criteria: Does the Modification ...	Answer Yes/No	Evaluation Result (Explain)
1	Add a new building or facility with material inventories >/= HC-3 inventory limits or increase HC of an existing facility?	No	DWPF is an existing HC-2 nuclear facility. The Alternate Reductant Project does not introduce any new radiological material to the facility. There is no impact to the facility hazard categorization based on this project. The quantity of material at risk will not be increased.
2	Change the footprint of an existing HC-1, 2 or 3 nuclear facility with the potential to adversely affect any SC/SS safety function or associated SSC?	No	The facility will be using Formic Acid Tank 2 as the hold tank for glycol solution. This tank has been empty because there was no need for a backup tank for formic acid additions. The footprint will be maintained the same and there will be no adverse effect to any SC/SS safety function.
3	Change an existing process or add a new process resulting in the need for a safety basis change requiring DOE approval?	Yes	The goal of the project is to reduce the hydrogen generation rate in the process vessels. Changes to the process include replacing formic acid with glycolic acid as a reductant and removing formic acid from Process Frit. This will impact the TSRs for CPC Flammability Monitoring, Flammability Control and Melter Feed Contents. The vessel purge controls wil remain, but the required purge flows will be reduced. Also, the Melter Feed Contents LCO will retain the existing format, but will contain equations that account for glycolic acid. These changes will result in a safety basis change requiring DOE Approval.
4	Utilize new technology or government funded equipment (GFE) not currently in use or not previously formally reviewed/ approved by DOE for the affected facility?	No	Although the constituent of glycol will be new to the DWPF flowsheet chemistry, the use of glycol is well understood in the industry and throughout the DOE complex. Glycol has been used as a decontamination agent and clarifier. The project has identified another use for the solution that is in line with previous utilization throughout the complex.
5	Create the need for new or revised safety SSCs?	Yes	The introduction of glycol will reduce the hydrogen generation rate in the process vessels. Currently hydrogen is measured by Safety Significant Gas Chromatographs (GCs) to determine if its concentration is above the TSR limit. The hydrogen will be reduced to almost non-detectable. This may result in the GC systems being removed from service.
6	Involve a hazard not previously evaluated in the Documented Safety Analysis (DSA)?	No	The generation of hydrogen and the effects to the DWPF process are already analyzed in the FSAR. The introduction of glycol and the removal of formic acid create a condition whereby hazards previously evaluated could be eliminated or significantly reduced. The current project will provide the conditions for elimination of the hazard and management of the residual hydrogen formation.
	Is the modification a Major Modification as defined in DOE-STD-1189?	No	

Summary and Recommendations

Although criteria 3 and 5 were tripped, this evaluation determined that this project is not a Major Modification. Changes to the process include replacing formic acid with glycolic acid as a reductant and removing formic acid from Process Frit. The changes to the process may also result in removing the GCs. This would only be done after laboratory testing has confirmed the elimination of the catalytic hydrogen hazard. Description of these changes along with any resulting changes in controls will result in a safety basis change requiring DOE Approval. However, the overall hazards associated with the DWPF process will be reduced by this project. The vessel purge controls will remain the same but the required purge flows will be reduced. Additionally there will be some changes to the Melter Feed Contents TSR to account for the glycolic flowsheet and the elimination of formic acid. It is concluded that there is not a significant Safety Basis risk associated with this project, therefore there is no need for a PDSA. The changes to the existing DSA/TSR to reflect this project will be made following the normal DSA/TSR change process. Therefore, the project is not a Major Modification.

Design Authority Peter Flores L0499	Date 11/20/2014
Safety Basis Regulatory Authority	Date 11-20-14

Attachment B: Sr. SIRC Slides

Savannah River Remediation

AECOM | BECHTEL | CH2M HILL | B&W | AREVA

DWPF PISA RESOLUTION PATH FORWARD APPROACH

April 14, 2015

SAVANNAH RIVER SITE • AIKEN, SC • www.SRRemediation.com

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Purpose

We do the right thing.

- **To obtain concurrence from Sr. SIRC on the proposed long-term approach to resolve two DWPF PISAs.**

- **To obtain concurrence from Sr. SIRC on the proposed interim strategy related to the Melter Off-gas PISA to resume limited bubbled operations.**

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Background

We do the right thing.

Currently 2 PISAs in DWPF

- **Melter Feed Rate Temperature Correlation Basis**
  - Currently operating using compensatory measures established in the ESS
    - Melter agitation bubblers are not in operation while feeding the melter
  - Directly impacts the canister production of the facility

  - Short-term strategy: Use existing model to develop new correlation (feasibility complete)
  - Mid-term strategy: Backfit of Melter feed flow instrumentation
  - Long-term strategies: Direct off-gas monitoring (feasibility complete)
    New melter feed delivery system – ADS Pump (feasibility complete)
    Backfit of Zone 1 Ventilation to Safety Class

- **Retained Hydrogen in DWPF Vessels**
  - Currently operating using actions to place facility in a safe condition outlined in PISA-2015-0013
  - Does not directly impact production of the facility
    - Risk currently exists related to agitator stoppage during catalytic generation

  - Short-term strategy: Engineering evaluation required if agitator is stopped for > 1 hour
  - Long-term strategies: Backfit of Zone 1 Ventilation to Safety Class
    Release rate and retention rate studies/evaluations
    Alternate Reductant (evaluate opportunity to resolve catalytic risks)

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Accident Scenarios

We do the right thing.

Melter off-gas explosion is dependent on the occurrence of a bounding surge of noncondensable gases during a period of time that a high feed rate produces combustibles which exceed the off-gas combustion and dilution capacity.

- **Basis assumes that the bounding surge occurs during a period of overfeeding the melter with a feed stock with bounding characterization (e.g. solids, TOC, etc.).**

****

Initiators for explosions in the CPC vessels assume that a spark source is present during the release of retained gases upon agitator restart that are greater than the concentration assumed in the vessel purge system calculation.

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Current Control Strategy

We do the right thing.

- **Explosion in the Melter Off-gas**
  - 1st LOC – Melter Off-gas System Instrumentation & Associated Interlocks
    - Ensure adequate dilution and combustion air flow to film coolers and steam pressure and shut off melter feed pumps if either is low.
  - 1st LOC – Melter Vapor Space Temperature Instrumentation & Associated Interlocks
    - Ensure adequate temperature in melter vapor space and shut off melter feed pumps on low temperature.
  - 1st LOC – Load Lift Program
    - Prevent crane load drops which could impact safety related equipment for this event.
  - 2nd LOC – Zone 1 Ventilation System
    - Mitigates effects of internal radiological process events with a minimum DF of 200.
  - 3rd LOC – The RPC walls have the SS function to provide shielding for workers in the Vitrification Building

****

- **Explosion in CPC/SPC Vessels**
  - 1st LOC – CPC Safety Grade Nitrogen Purge System
    - Prevents explosions in the process vessel and the connected vent piping.
  - 1st LOC – Load Lift Program
  - 2nd LOC – CPC Primary Purge System
    - Prevents explosions in the process vessel and the connected vent piping.
  - Multiple controls support the 1st and 2nd LOC
    - TSR WAC Control, SEFT Dilution Program, CPC/SPC Purge Flow Meters and Associated Interlocks, etc.
  - 3rd LOC – Zone 1 Ventilation
    - Mitigates effects of internal radiological process events with a minimum DF of 200.

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Proposed Solution

We do the right thing.

- **Proposal will change the 1st LOC from a preventer to a mitigator**
- **Use the Backfit Analysis Process to qualify Zone 1 Ventilation System as Safety Class (SC)**
  - Also requires the process be applied to the Diesel Generator and Diesel Fuel Oil Systems
- **Zone 1 Ventilation will become 1st LOC for both PISA scenarios**
- **Expected to take approximately 18 months to complete.**
  - Includes backfit analysis and any associated work to implement the LOCs
- **Overall scope of work, obsolescent equipment, and potential design scope are probable challenges to completing the backfit analysis.**

<u>Accomplishes 2 goals</u>

Goal 1: PISA resolution

Goal 2: Reduce vulnerability by decreasing reliance on mechanistic models

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Explosions in the Melter Off-gas

We do the right thing.

- **1st LOC: Zone 1 Ventilation**
  - Mitigates effects of internal radiological process events with a minimum DF of 200
  - Engineering controlled mitigater more robust than a model preventer

- **2nd LOC: Melter Off-gas Flammability Model implemented through programmatic controls**
  - Ensures adequate dilution and combustion air
  - Ensures adequate vapor space temperature
  - Minimum values will continue to be determined using the best inputs and assumptions available, and understanding that the model contains dynamic interactions that are dependent upon multiple variables
    - Programmatically include an assessment and maintenance frequency to update the model with new information and latest data

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Explosions in CPC Vessels

We do the right thing.

- **Applies to CPC Vessels only for this accident scenario**
  - LPPP vessels are excluded from this scenario
- **1st LOC: Zone 1 Ventilation (Retained gas initiator)**
  - Mitigates effects of internal radiological process events with a minimum DF of 200.
- **2nd LOC: CPC Safety Grade Nitrogen Purge System (Retained gas initiator)**
- **3rd LOC: CPC Primary Purge System (Retained gas initiator)**
  - Prevents explosions in the process vessel and connected vent piping
- **Programmatic Control to support 2nd and 3rd LOC**
  - Release rate studies/historical data
  - Retention rate studies/historical data
- **Initiators other than retained gas LOC are unchanged**
- **Applying this control strategy allows the DWPF to leverage work and resources used during the MOG PISA resolution process to resolve the Retained Hydrogen in DWPF Vessels PISA.**
- **In the event an upset condition occurs in the CPC Vessels these LOCs will be in place to provide protection.**

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Interim Strategy for Melter Feed

We do the right thing.

Reduce production impact due to Melter feed rate PISA

- **Backfit Analysis Process to qualify current feed flow instrumentation**
  - Include in the suite of controls listed as 1st LOC
  - Allow for feeding the melter with agitation bubblers in operation
  - Plans are to not provide redundancy for the interim control
- **Provides a replacement control to an input to the Melter Off-gas model**
  - Reduces the risk associated with the model
- **Consolidated Hazard Analysis (CHA) review**
  - Determination of hardwire vs. software interlock for feed pump shutdown
    - Impacts the extent of design work needed for implementation
- **Uncertainty calculation for flow instrumentation**
  - Likely to limit maximum feed rate to a range of 1.0 to 1.2 gpm
- **Expected to take approximately 6 months to complete**
  - Dependent primarily on the amount of design work necessary for implementation
- **This strategy provides a partial solution to eliminating the reliance on the model as a Safety Class control.**

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Path Forward

We do the right thing.

- **With concurrence from Sr. SIRC:**
  - Work will be initiated on the proposed long-term approach to resolved two DWPF PISAs with a 1st LOC that is a mitigator (Zone 1 Ventilation).
  - Work will be initiated on the proposed interim strategy related to the Melter Off-gas PISA to resume limited bubbled operations by crediting the feed flow instrumentation to protect over feeding of the melter.

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

BACKUP

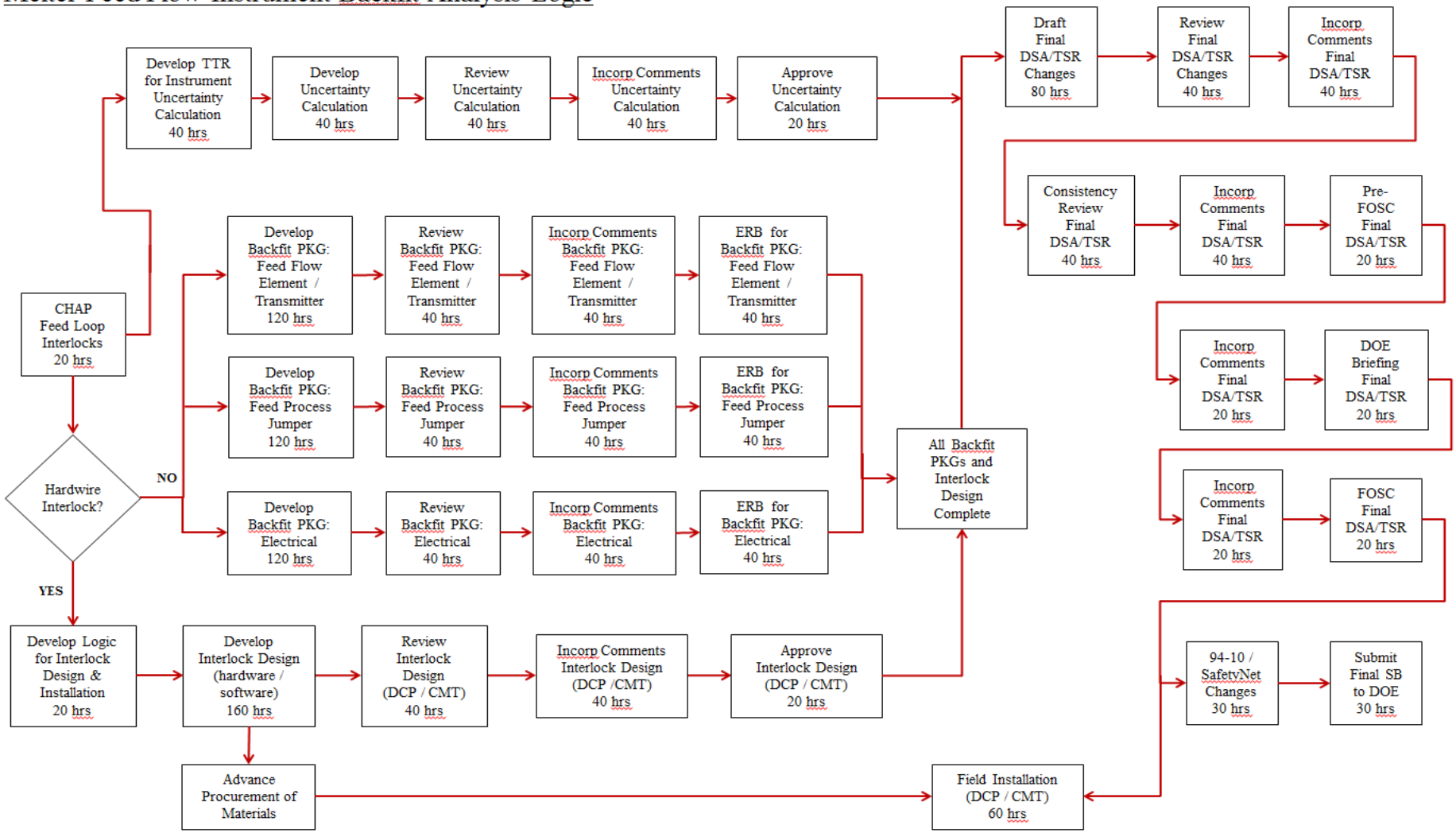
We do the right thing.

Savannah River Remediation
AECOM | BECHTEL | CH2M HILL | B&W | AREVA

Proposed Interim Strategy

We do the right thing.

Melter Feed Flow Instrument Backfit Analysis Logic



ATTACHMENT 2

U-ESS-S-00001, Rev. 1

U-ESS-S-00001
Revision 1
October 2015

Evaluation of the Safety of the Situation (ESS): Melter Feed Rate Temperature Correlation Basis (PISA PI-2014-0009)

APPROVALS

E. M. Riddick, Author — Date: 10/26/15

W. A. Condon, Technical Reviewer — Date: 10/27/15

T.H. Huff, LW Safety Basis Regulatory Authority — Date: 10.29.15

E.J. Freed, Manager, DWPF Engineering — Date: 11-18-15

W.M. Barnes, Facility Manager, DWPF — Date: 11-19-15

1.0 PISA Description/Summary

Potential Inadequacy in the Safety Analysis (PISA) PI-2014-0009 pertains to the Defense Waste Processing Facility (DWPF) Final Safety Analysis Report (FSAR), WSRC-SA-6, and is described in the PISA Database as follows:

> "The feed rate to the melter is one of the inputs into the melter flammability analysis. The overfeed condition is protected by a melter vapor space low temperature interlock (LCO 3.3.1). The basis for this interlock setpoint is a heat model that was performed using assumptions that were valid before the installation of melter bubblers but have not been updated. The interlock setpoint may be non-conservative for operations with the melter bubblers."

Additional information pertaining to PISA PI-2014-0009 includes:

- Date of Discovery: 11/19/2014
- ORPS Report Number: EM-SR--SRR-WVIT-2014-0017

References pertaining to PISA PI-2014-009 include:

1. Defense Waste Processing Facility Final Safety Analysis Report, WSRC-SA-6, Rev. 33.
2. Technical Safety Requirements Defense Waste Processing Facility, WSRC-TS-95-0019/S-TSR-S-00001, Rev. 53.
3. Integration of the Uncertainties of Anion and TOC Measurements into the Flammability Control Strategy for Sludge Batch 8 at the DWPF, SRNL-STI-2013-00139, Rev. 0.
4. Choi, A.S., DWPF Melter Off-Gas Flammability Assessment (Sludge Batch 8), X-CLC-S-00164, Rev. 8.
5. Choi, A.S., Maximum Vapor Space Temperature During DWPF Melter Operation With Glass Pump at 1.5 GPM Feed Rate, X-CLC-S-00139, Rev. 0.
6. Choi, A.S., Steady State Indicated Temperature of DWPF Melter Vapor Space at 1.5 GPM Feed Rate, X-CLC-S-00096, Rev. 0.
7. Choi, A.S., DWPF Melter Off-Gas Flammability Assessment (Sludge Batch 6), X-CLC-S-00164, Rev. 2.

2.0 Compensatory Measures / Operational Restrictions

2.1 PISA Compensatory Measures / Operational Restrictions

The following Compensatory Measure is currently in place as documented in PISA PI-2014-0009:

2.1.1 Prohibit operations of the DWPF melter in bubbler mode, thereby avoiding operations in the condition where the low temperature interlock setpoint may be non-conservative.

2.2 ESS Compensatory Measures / Operational Restrictions

Based on the evaluation provided in Section 3.1, PISA Compensatory Measure 2.1.1 will remain in place as clarified below:

2.2.1 When the DWPF melter is in Operation Mode, use of the agitation bubblers is prohibited, thereby avoiding operations in the condition where the low temperature interlock setpoint may be non-conservative.

When the DWPF melter is in Standby Mode, feeding the melter is prohibited by the existing TSRs; therefore, the agitation bubblers may be used.

3.0 Safety Assessment Results

3.1 Immediate Safety Assessment

Section 11.5.5.2 of Reference 1 states that the parameters that directly affect the flammable fuel concentration include the controls on melter feed contents, melter vapor space temperature, the melter feed rate (limited by the melter vapor space low temperature interlock), the combustion air (by measuring the backup off-gas film cooler air flow), and the dilution air (by measuring the total melter air flow). By controlling these parameters the flammable fuels are oxidized in the melter in a controlled fashion. The safety analysis limits for the melter feed contents are a maximum TOC concentration on a slurry basis and a maximum carbon concentration from antifoam on a slurry basis (Ref. 4). Implementing these limits with uncertainties applied per the methodologies identified in Reference 3 ensures the flammable constituents produced in the melter are within the bounds of the melter off-gas flammability calculation (Ref. 4). These limits on melter feed contents are protected by LCO 3.1.8 and as long as they are maintained, any distribution of the identified carbon contributors is bounded by the existing analysis and will result in a lower melter off-gas flammability concentration. These limits are based on a maximum feed rate of 1.5 gpm to the melter. Section 11.5.5.2 of Reference 1 as well as Reference 4 state that the maximum feed rate of 1.5 gpm is protected by the melter vapor space temperature indicators and associated interlock protected by LCO 3.3.1.

It has been determined that the statements and conclusions above are valid for melter operation without the agitation bubblers in operation (i.e., non-bubbled) which has been validated in the past (Ref. 6 and 7). Present operation with the agitation bubblers may cause the relationship between the max feed rate and minimum temperature to change in a non-conservative direction as it relates to the present FSAR/TSR limits. This is supported by data obtained during melter operation with the agitation bubblers in May 2014. The melter feed rate setpoint was 1.5 gpm for approximately 8 hours beginning on May 14, 2014. During this time the lowest vapor space temperature indicated was 645 °C. This temperature is significantly greater than the TSR limit of 493 °C, which is credited to interlock off the melter feed pumps if melter feed rate exceeds 1.5 gpm.

The following scenarios in the FSAR are potentially affected if the melter is in Operation Mode with the agitation bubblers operating while slurry feed is being transferred to the melter, thereby potentially causing the melter vapor space minimum temperature interlock setpoint to be non-conservative:

- FSAR Section 9.4.2.3 - Explosions in the Melter Off-Gas
- FSAR Section 9.4.2.13 - Earthquake
- FSAR Section 9.4.2.14 - High Winds

For each of these FSAR scenarios, further discussion is provided below to assess potential impacts to the reported consequences and evaluation of related controls/Compensatory Measures. When control sets are described below, the controls supporting integrity/functionality of credited Structures, Systems, and Components are not listed.

<u>FSAR Section 9.4.2.3 - Explosions in the Melter Off-Gas</u>

The FSAR reported consequences for this scenario are:

- Unmitigated and mitigated Offsite: < 9.5 rem
- Unmitigated Onsite: >100 rem
- Mitigated Onsite: 0 rem

The unmitigated offsite consequence does not challenge the Offsite Evaluation Guideline (EG) and requires no Safety Class (SC) controls. Thus, for protection of the public, no new SC controls would be required and no Compensatory Measures are required.

The radiological consequence to the onsite receptor exceeds the Interim Guidance Evaluation Guidelines (IGEG) and requires Safety Significant (SS) controls. The SS controls credited for this scenario are listed below:

1st LOC – Melter Off-Gas System Instrumentation and Associated Interlocks (LCO 3.3.1) - Provide indication of dilution and combustion air flow to the primary and backup off-gas film coolers and steam pressure to ensure a flammable mixture is not formed in the off-gas system. The interlocks shut off both melter feed pumps if the combustion or dilution air flow for the off-gas or steam pressure is low.

1st LOC – Melter Vapor Space Temperature Instrumentation and Associated Interlocks (LCO 3.3.1) - Provide indication of the melter vapor space temperature and interlock off the melter feed pumps on low temperature.

The 1st LOCs above are supported by a TSR control on Melter Feed Contents (LCO 3.1.8) which prevents excessive combustible off-gas compounds. Additionally, in order for the interlock limits to be valid, when the melter is in the operating mode, it must be aligned to the primary off-gas system (LCO 3.3.1).

1st LOC – Load Lift Program - Prevents crane load drops which may impact the safety related equipment for melter off-gas explosion events.

2nd LOC – Zone 1 Ventilation System – Mitigates effects of internal radiological process events with a minimum DF of 200.

The Vitrification Building, including the RPC Walls, supports the Zone 1 Ventilation System airflow configuration.

3rd LOC – The RPC Walls have the safety significant function of providing shielding for the workers within the Vitrification Building.

The 1st SS LOC above prevents the off-gas explosion and therefore the consequence of the SS mitigated scenario is zero rem for the onsite receptor. However, the existing setpoint for the melter vapor space temperature instrumentation and associated interlocks may be non-conservative for operations with the melter agitation bubblers. Therefore, the PISA Compensatory Measure 2.1.1 was put in place to prohibit operations of the DWPF melter agitation bubblers while in Operation Mode, thereby avoiding operations in the condition where the low temperature interlock setpoint may be non-conservative.

The PISA Compensatory Measure 2.1.1 and ESS clarification 2.2.1 have been implemented via the Immediate Procedure Change (IPC) process and includes proceduralized steps to ensure that the argon supply to each agitation bubbler is locked CLOSED in melter Operation Mode.

FSAR Section 9.4.2.13 - Earthquake

The FSAR reported mitigated Offsite and Onsite consequences for the Explosions in the Melter Off-Gas scenarios stated above for a Seismic Event are 0 rem (i.e., prevented).

A Seismic Event is a credible initiator of an explosion in the melter off-gas. The first level of control to prevent the explosion in the melter off-gas is the melter vapor space temperature instrumentation and associated interlocks, the total melter air flowmeter/switch, the backup off-gas film cooler air flow meter/switch, the OGFC and BUOGFC steam line pressure switches, and the associated interlocks (discussed in FSAR section 9.4.2.3). This equipment is required to remain operable during and following a Seismic Event to prevent the melter explosion. Because the roll-up of the unmitigated consequences of a Seismic Event would challenge the EG, these controls are required to be SC and seismically qualified to PC-3.

However, as in the discussion for FSAR Section 9.4.2.3 (Explosions in the Melter Off-Gas), the existing setpoint for the melter vapor space temperature instrumentation and associated interlocks may be non-conservative for operations with the melter agitation bubblers. Therefore, the PISA Compensatory Measure 2.1.1 was put in place to prohibit operations of the DWPF melter agitation bubblers while in Operation Mode, thereby avoiding operations in the condition where the low temperature interlock setpoint may be non-conservative. This compensatory measure is effective for the Seismic Event scenario since there is no credible mechanism for a Seismic Event to "start" a locked out bubbler.

FSAR Section 9.4.2.14 - High Winds

The FSAR reported mitigated Offsite and Onsite consequences for the Explosions in the Melter Off-Gas scenarios stated above for a Tornado and High Winds Event are 0 rem (i.e., prevented).

A Tornado and High Winds Event is a credible initiator of an explosion in the melter off-gas. The controls identified to prevent the melter off-gas explosion identified in FSAR section 9.4.2.3 are required to perform their safety function. These are not required to be high winds qualified as they are protected by the vitrification building with the exception of the interlock on melter feed pump #2. A TSR administrative control is required to stop this melter feed pump upon receipt of a tornado warning to prevent a melter off-gas explosion.

However, as in the discussion for FSAR Section 9.4.2.3 (Explosions in the Melter Off-Gas), the existing setpoint for the melter vapor space temperature instrumentation and associated interlocks may be non-conservative for operations with the melter agitation bubblers. Therefore, the PISA Compensatory Measure 2.1.1 was put in place to prohibit operations of the DWPF melter agitation bubblers while in Operation Mode, thereby avoiding operations in the condition where the low temperature interlock setpoint may be non-conservative. This compensatory measure is effective for the

Tornado and High Winds Event scenarios since there is no credible mechanism for a Tornado/High Wind Event to "start" a locked out bubbler.

3.2 Final Safety Assessment

An Unreviewed Safety Question Evaluation (USQE), USQ-WD-2014-00697, was performed for PISA PI-2014-0009 and resulted in a "positive" evaluation. The facility continues operation with the Compensatory Measure identified in the PISA in place (See section 2).

The USQE was "positive" based on a "Yes" answer to the following Question:

> "Does the PISA increase the probability of occurrence of an accident previously evaluated in the Safety Bases?"

FSAR section 11.5.5 states that the feed rate is a bounding flow at which the melter can be controlled without forcing the low temperature interlock to shut off the melter feed pumps. It has been determined that the controls and setpoints credited to prevent the "Explosions in the Melter Off-Gas" scenarios are valid only for melter operation without the agitation bubblers in operation which has been validated in the past. Present operation with the agitation bubblers may cause the relationship between the max feed rate and minimum temperature to change in a non-conservative direction as it relates to the present FSAR/TSR limits. The maximum melter feed rate may be exceeded prior to actuation of the melter vapor space low temperature interlock. Therefore, the probability of occurrence of an accident previously evaluated in the Safety Basis may increase.

As discussed in Section 3.1, FSAR scenarios associated with this PISA are prevented such that the Offsite and Onsite EGs are not challenged/exceeded. However, the existing setpoint for the melter vapor space temperature instrumentation and associated interlocks may be non-conservative for operations with the melter agitation bubblers. Therefore, the PISA Compensatory Measure 2.1.1 and ESS clarification 2.2.1 were put in place to ensure that when the DWPF Melter is in Operation Mode, use of the agitation bubblers is prohibited, thereby avoiding operations in the condition where the low temperature interlock setpoint may be non-conservative.

The current operational status of the facility is impacted by the Compensatory Measure of this PISA and ESS. Melter system operation may continue using procedures as amended by this Compensatory Measure. However, Compensatory Measure 2.2.1, prohibits agitation bubblers from operating when the melter is in Operation Mode which results in reducing the melter slurry feed rate. This nearly doubles the time required to fill a canister and reduces the number of canisters that can be filled each month.

3.3 Path Forward

1. Continue to implement the Compensatory Measure discussed in section 2.2.

2. Pursue the following options to establish Safety Basis controls for operation of the agitation bubblers:
   a. Revise the heat model for agitation bubbler operation.
   b. Develop a creditable feed rate control using feed flow instrumentation.
   c. Develop a system to monitor the melter off-gas directly.
   d. Develop an alternate feed system design that has physical limitations to prevent melter overfeeding.
   e. Redefine the control strategy for Melter Off-Gas to include mitigation as the primary control while changing the preventive strategy to a significant contributor to defense in depth.
3. Revise the associated accident analysis and Safety Basis related to Item 2a, 2b, 2c, 2d, and/or 2e above.

Items 2a through 2e will be worked in parallel until the best path for resolution is determined.

3.4 Summary of Recommendations and Conclusions

Based on the results of USQ-WD-2014-00697 and evaluation of PISA PI-2014-0009, the PISA and ESS Compensatory Measure will remain in place until a permanent change is made to the Safety Basis and associated support documents. In order to support the milestones for the Alternate Reductant Project, the Safety Basis changes for this PISA will be incorporated into the DWPF FY2016 Annual Update, which will be implemented by January 31, 2017.

ATTACHMENT 3

U-ESS-S-00002, Rev. 1

U-ESS-S-00002
Revision 1
October 2015

Evaluation of the Safety of the Situation (ESS): Retained Hydrogen in DWPF Vessels (PISA PI-2014-0013)

APPROVALS

Emily Riddick — Date: 10/26/15
E. M. Riddick, Author

Date: 10/27/15
W. A. Condon, Technical Reviewer

Date: 10.29.15
T.H. Huff, LW Safety Basis Regulatory Authority

Date: 11-18-15
E.J. Freed, Manager, DWPF Engineering

Date: 11-19-15
W.N. Barnes, Facility Manager, DWPF

1.0 PISA Description/Summary

Potential Inadequacy in the Safety Analysis (PISA) PI-2014-0013 pertains to the Defense Waste Processing Facility (DWPF) Documented Safety Analysis (DSA), WSRC-SA-6, and is described in the PISA Database as follows:

"The DWPF Safety Basis does not specifically address the issue of flammable gas retention in DWPF vessels. If agitation in DWPF vessels is stopped, there is a potential for radiolytically generated gasses to be retained in the sludge and subsequently released on agitator restart. The current preventative safety controls for CPC and Low Point explosion do not address the release of retained gases."

Additional information pertaining to PISA PI-2014-0013 includes:

- Date of Discovery: 12/16/2014
- ORPS Report Number: EM-SRR-WVIT-2014-0018

References pertaining to PISA PI-2014-0013 and/or this ESS include:

1. WSRC-TS-95-0019/S-TSR-S-00001, Rev. 53, November 2014, "Technical Safety Requirements Defense Waste Processing Facility."
2. WSRC-SA-6, Rev. 33, July 2014, "Final Safety Analysis Report Savannah River Site Defense Waste Processing Facility."
3. PISA: PI-2014-0009, November 19, 2014 "Melter Feed Rate Temperature Correlation Basis."
4. SBD-S-12-001, Rev. 3 (11/4/14) "Revised process description of steam supplied to HVAC system" (Change to FSAR, Rev. 33, Chapter 5).
5. SBD-S-14-002, Rev. 1, (8/14/14) "Revision to add SWPF/DWPF Interarea Transfer Line cathodic protection bonding cable" (Change to FSAR, Rev. 33, Chapter 1).
6. SBD-S-14-006, Rev. 1. (11/4/14) "Revision to add REDC electric steam boiler" (Change to FSAR, Rev. 33, Chapters 1, 5, and 9).
7. SBD-S-14-007, Rev. 0, (12/04/14) "Revision to allow the use of an alternate drain line for the Gas Chromatograph sample return line" (Change to FSAR, Rev. 33, Chapter 6)
8. WSRC-TR-2007-00174 Rev. 1, DWPF's SME De-Inventory Plan Configuration Managed Documents.
9. WSRC-TS-95-0019/S-TSR-S-00001, Rev. 2014-B, TBD, "Defense Waste Processing Facility Technical Safety Requirements."
10. WSRC-TS-95-0019/S-TSR-S-00001, Rev. 2014-C, TBD, "Defense Waste Processing Facility Technical Safety Requirements."
11. WSRC-TS-95-0019/S-TSR-S-00001, Rev. 2014-D, TBD, "Defense Waste Processing Facility Technical Safety Requirements."
12. SBD-S-14-003, Rev. 0, DWPF Interim Purge Modifications.

13. SBD-S-14-003, Rev. 1, DWPF Final Purge Modifications.
14. SBD-S-14-004, Rev. 0, DWPF Antifoam Tracking Program.
15. S-CLC-S-00148, Rev. 0, Consequences of Explosions in the DWTT, RCT, and LPPP RPT.
16. S-CLC-S-00106, Rev. 3, DWPF Natural Phenomena Consequences, Earthquake and Tornado (U).
17. S-CLC-S-00101, Rev. 1, Hydrogen Explosion Accident Analysis for Actinide Removal Process in DWPF.
18. USQ-WD-2014-00745, PI-2014-0013, Retained Hydrogen in DWPF Vessels.
19. S-CLC-S-00104, Rev. 1, 512-S Facility Consolidated Hazard Analysis Process (CHAP) Basis (U).
20. WSRC-TR-95-0198, DWPF Mode C Probabilistic Safety Analysis.
21. WSRC-TR-2002-00223, Rev. 5; 512-S Facility and Defense Waste Processing Facility Transfer Lines Consolidated Hazard Analysis (U).
22. N-CLC-S-00025, Rev. 0, DWPF Mode C Accident Selection (U).
23. DOE-STD-1020-94, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities.
24. WSRC-SA-2002-0007, Rev. 16; Concentration, Storage, and Transfer Facilities, Documented Safety Analysis.
25. X-CLC-S-00329, Rev. 0, Quiescent Times for the Recycle Pump Tank and Sludge Pump Tank.
26. X-CLC-S-00333, Rev. 0, Justification for Vessels Not Included in PI-2014-0013.
27. X-ESR-H-00551, Rev. 1, Evaluation of ISDP Batch 7 Qualification Compliance to 512-S, DWPF, Tank Farm, and Saltstone Waste Acceptance Criteria.
28. S-CLC-S-00103, Rev. 2, Explosions in ARP/DWPF Process Cells (U).
29. X-ESR-S-00247, Rev. 0, Quiescent Times for Vessels in the Chemical Process Cell.

2.0 Compensatory Measures / Operational Restrictions

2.1 PISA Compensatory Measures / Operational Restrictions

The following Compensatory Measures are documented in the PISA Database for PI-2014-0013:

"Prohibit starting a stopped agitator in the following vessels without performing an engineering evaluation to determine that the release of retained gas will not exceed 95% CLFL. Restart after temporary shutdown (<1hr for operation evolutions) is allowed without evaluation.

LPPP SPT
LPPP RPT
SRAT
SME
MFT
DWTT
RCT
SMECT (the scrubber and sample pumps are the source of agitation for the SMECT so restart of either is prohibited without evaluation if both were secured. If only one is secured, it may be restarted without evaluation).

Engineering Evaluation may consider the following:
• Actual tank inventory
• Actual waste characteristics
• Agitator down-time
• Actual tank temperature
• Gas retention rate based on tank inventory
• Maximum retention potential (maximum bubble fraction of 0.2)
• Hydrogen fraction in total gas based on WSRC-SA-2002-00007 revision 15 section 3.4.1.5.2.
• Exclusion of catalytic hydrogen generation"

According to PI-2014-0013, the actions listed above are justified by the following:

"Tanks not listed above do not contain sufficient solids inventory to retain gasses
By prohibiting agitator start, the unanalyzed retained gas is not released. The evaluations use assumptions consistent with the CSTF DSA for similar applications (actual waste etc). Use of CSTF DSA assumptions is considered acceptable because the DWPF process has the same material as CSTF until SRAT acid addition. The acid addition tends to lower the yield stress of the material which should tend to reduce the capacity to retain gas bubbles.
Exclude catalytic hydrogen generation based on settling rate, cooling, loss of agitation

slows reaction, acid addition significantly alters material rheology affecting ability to retain gasses."

2.2 ESS Compensatory Measures / Operational Restrictions

2.2.1 Prohibit starting a stopped agitator in the following vessels without performing an engineering evaluation to determine that the release of retained gas will not exceed 95% CLFL. Restart after temporary shutdown (< 1hr for operation evolutions) is allowed without evaluation.

SRAT
SME
MFT
DWTT
RCT
SMECT (the scrubber and sample pumps are the source of agitation for the SMECT so restart of either is prohibited without evaluation if both were secured. If only one is secured, it may be restarted without evaluation).

The Engineering Evaluation will consider the following:
• Actual tank inventory
• Actual waste characteristics
• Agitator down-time
• Actual tank temperature
• Gas retention rate based on tank inventory
• Gas retention potential based on WSRC-SA-2002-00007 Rev. 16 Section 3.4.1.5.3
• Hydrogen fraction in retained gas based on WSRC-SA-2002-00007 Rev. 16 Section 3.4.1.5.3
• Inclusion of catalytic hydrogen generation for tanks having potential catalytic hydrogen (SRAT and SME)
• Ventilation

Tanks not listed above are excluded based on Reference 26. They are not capable of retaining enough gas to challenge LFL. The Engineering Evaluation may use assumptions consistent with the CSTF DSA for similar applications (actual waste, etc). The use of CSTF DSA assumptions is considered acceptable because the DWPF process has the same material as CSTF until SRAT acid addition. The acid addition tends to lower the yield stress of the material which tends to reduce the capacity to retain gas bubbles; therefore, this approach is conservative. Additionally, the adequacy of this compensatory measure regarding CPC vessels is due to the low catalytic hydrogen generation rate of Sludge Batch 8. It is assumed Sludge Batch 9 is similar. If not, this compensatory measure will be re-evaluated.

2.2.2 Agitate the LPPP SPT and the LPPP RPT for two hours at the time interval determined in Reference 25 or an equivalent evaluation. The Gas Chromatograph (GC) readings given in Reference 29 indicate that two hours is adequate.

2.2.3 Ensure that DWPF is processing either Sludge Batch 8 or a sludge batch coupled with a salt batch where the Inhalation Dose Potential (IDP) of the resulting SRAT stream is less than or equal to 20% of the current DSA IDP for the SRAT stream based on DSA Table 9.4-1a.

3.0 Safety Assessment Results

3.1 Immediate Safety Assessment

This PISA affects the following FSAR events:

1. Explosions in CPC/SPC Vessels
2. Explosions in 512-S Vessels
3. Explosions in LPPP Vessels
4. Earthquake
5. High Winds

Two additional events, a cell explosion following a process spill and a cell explosion following an earthquake-caused spill, are eliminated in the FSAR on the basis of the time to CLFL being greater than four days. Based on the following, the justification for eliminating these events continues to be valid considering the possible release of additional retained gas.

a) The release of retained gas as a result of a process spill would occur simultaneous with the spill. The cell continues to be ventilated during the spill and appreciable amounts of hydrogen will not accumulate in the cell vapor space.

b) The seismic cell explosion scenario (either CPC or LPPP) postulates spilling various process tanks into the cell. It is shown in Reference 28 that the time to reach CLFL in either cell under conservative spill volumes, generation rates, etc., is greater than four days.

The LPPP cell explosion scenario assumes transfers into the cell are ongoing at the time of the DBE. Prior to the initiation of a transfer, the receiving tank can be assumed to be at heel. This limits the amount of hydrogen retaining sludge that may be present during the scenario and, therefore, limits the effect that the release of retained sludge might have on the time to CLFL in the cell. This effect is judged not to be sufficient to reduce the calculated time to CLFL to less than four days. Alternate scenarios that eliminate the

transfers and assume instead that LPPP tanks are at their maximum levels, including levels of hydrogen-retaining sludge, remain bounded by the analyzed scenario.

Two CPC seismic scenarios are analyzed. Both assume multiple tanks spill. The high temperature scenario assumes the spills occur at 105 deg C. Tanks at 105 deg C are being agitated and contain no retained gas. The high volume scenario assumes a greater total spill volume but at a lower temperature. CPC tanks other than the DWTT are normally agitated or at heel. If they are agitated, they will contain no retained gas. If they are at heel, the inventory of retained gas would be small and the total hydrogen generation rate (in ft^3/hr) would be lower than the rate used in the DSA analysis, which is based on greater liquid levels. Furthermore, a larger cell vapor space would exist following a spill of tanks at heel compared to the vapor space that exists when those tanks contain the DSA assumed spill volumes. The DWTT contains a limited amount of sludge (~ 1000 gal at most), and, therefore, retained gas, even when it is near capacity. Based on these considerations, the release of the maximum possible retained gas inventory into the CPC in the event of a DBE would not reduce the time to CLFL to less than four days as required per the DSA to eliminate the event.

Per Reference 2, screening analyses have been performed on postulated chemical releases from accidents involving DWPF. These analyses are extremely conservative and the presence of retained gas would not alter their conclusions.

3.1.1 Explosions in CPC/SPC Vessels

Explosions are possible in CPC/SPC vessels (SEFT, PRFT, SRAT, SME, SMECT, MFT, RCT, and DWTT) as a result of the accumulation of flammable vapors in the vapor space of the vessels. Radiolytic hydrogen is generated in all vessels. Catalytic hydrogen is generated in the SRAT, SME, SMECT, MFT, RCT, and DWTT. Flammable gases other than hydrogen (e.g., Isopar L and ammonia) are present in some of the vessels.

The unmitigated scenario begins with a detonation in one of the tanks. The detonation causes cell covers to lift and fall causing the failure of the purge system on the other tanks and breeching of the melter off-gas system. Other tanks, except the melter, detonate and spill their contents leading to a pool fire. Molten glass from the melter is vented to the cell. Finally, falling debris or structural failure crushes glass containers within the vitrification building.

The contributions from explosions in CPC/SPC vessels other than the DWTT and the RCT are based on empty-tank stoichiometric conditions (Reference 17). As such, these are the maximum theoretical consequences for the given volume and the release of additional retained hydrogen, would not increase them. The contributions from explosions in the DWTT and the RCT are calculated as a function of liquid level in each tank with the worst-case occurring when a stoichiometric concentration is reached

(Reference 15). The release of retained gas would lower the level at which this concentration occurs and would increase the calculated consequences.

The unmitigated consequences of this scenario do not challenge offsite guidelines. The DSA-reported total offsite consequences are less than 9.5 rem including a contribution from the RCT explosion of 0.164 rem and a contribution from the DWTT explosion of 0.222 rem. These contributions are relatively small and increases in them caused by the release of retained gas would not result in the total consequences from the scenario challenging offsite guidelines.

The unmitigated consequences of this scenario exceed onsite evaluation guidelines. The consequences of the safety significant mitigated scenario are zero because explosions are prevented. The Compensatory Measures identified in Section 2.2 will ensure that 95% of LFL (or CLFL as appropriate) will not be exceeded upon agitation and the release of retained gas. Therefore, explosions continue to be prevented.

The unmitigated frequency of this event is judged to be Beyond Extremely Unlikely (BEU) (Reference 20). Per the USQE (Reference 18), the frequency of this event has increased.

3.1.2 Explosions in 512-S Vessels

Hydrogen is generated in 512-S vessels (LWHT, LWPT, backpulse tank, and crossflow filter) by radiolysis. The consequences of an explosion in any of these vessels are evaluated in Reference 19. The bounding unmitigated scenario is a deflagration in the LWPT (which contains 1600 gal of MST/Sludge Solids) that fails the vessel and produces enough collateral damage to cause detonations in the LWHT (at overflow), the crossflow filter (90% empty), and the backpulse tank (empty). Additional contributions result from liquid spills and damage to HEPA filters.

The selection of a deflagration instead of a detonation in the LWPT is based on the times to LFL and to stoichiometric. The release of trapped gas would not change this selection based on the limited inventory of trapped gas present in the LWPT (see Reference 26).

The mitigated consequences (safety class and safety significant) are identical to the unmitigated consequences, i.e., mitigation is not credited.

The unmitigated frequency of this event was determined to be Unlikely (Reference 21). Per the USQE (Reference 18), the frequency of this event has increased.

3.1.3 Explosions in LPPP Vessels

Hydrogen is generated in LPPP vessels (SPT, PPT, and RPT) by radiolysis. In addition, the RPT may contain Isopar L and ammonia. The bounding unmitigated scenario

addressed in the FSAR assumes one tank initially detonates, dislodges the cell covers which causes the failure of the purge system, and results in detonations of the other two tanks. Additional contributions to the consequences for the event include spills and a pool fire.

According to Reference 26, the PPT does not retain significant hydrogen because of its low inventory of solids. The detonation consequences for the SPT are based on an empty tank at the stoichiometric concentration of hydrogen (Reference 17). The release of retained gas would not affect this contribution. The detonation consequences for the RPT are based on the liquid level that gives the stoichiometric concentration in the vapor space (Reference 15). The release of retained gas would lower the level at which the stoichiometric concentration is reached and would, therefore, increase the consequences.

The unmitigated consequences of this event do not challenge offsite evaluation guidelines. The DSA-reported offsite consequences are < 1 rem. According to Reference 15, this includes a contribution of 0.0595 rem from the RPT. An increase in the contribution from the RPT as a result of retained gas would not cause the total consequences of the scenario to challenge offsite evaluation guidelines.

The unmitigated consequences of this event exceed onsite evaluation guidelines. The consequences of the safety significant mitigated scenario are zero because explosions are prevented by the LPPP Safety Grade purge system. Compensatory Measure 2.2.2 ensures that 95% of LFL (or CLFL as appropriate) will not be exceeded upon agitation of the SPT or the RPT and the release of retained gas. Therefore, the explosion continues to be prevented when retained gas is included.

The unmitigated frequency of this event was determined to be BEU (Reference 22). Per the USQE (Reference 18), the frequency of this event has increased.

3.1.4 Earthquake

The DBE event is a scenario involving many sub-events that contribute to the over-all consequences of the event (Reference 16). These sub-events include:

a) Explosions in process tanks in the vitrification building, 512-S, and the LPPP

b) Spills from process tanks in the vitrification building, 512-S, the LPPP, and transfer lines

c) Pool fires in the vitrification building and the LPPP

d) Releases from the melter and melter off-gas system

e) Releases from HEPA filters in 512-S

f) Releases from spent melters

g) Releases from crushed/damaged glass canisters.

The unmitigated consequences of this event exceed offsite and onsite guidelines. The presence of retained gas has the potential to increase the consequences of the explosion contributors to the total consequences. As mentioned previously, the explosion consequences for process tanks other than the RCT, DWTT, and RPT are based on empty tank, stoichiometric mixtures and will, therefore, not be increased with the addition of retained gas. The contributions from explosions in the RCT, the DWTT, and the RPT are calculated as a function of liquid level and may be increased by the release of trapped gas. However, as discussed previously with respect to the individual non-DBE events, the increases in these contributions will not have a significant effect on overall consequences. This remains true for the DBE.

In the DSA safety class mitigated and safety significant mitigated scenarios, explosions in the CPC/SPC and the LPPP tanks are prevented by the purge system. Because the DBE is not a planned agitation, however, Compensatory Measure 2.2.1 is not applicable and the purge system cannot be credited with preventing explosions in CPC/SPC tanks. Compensatory Measure 2.2.2 is applicable and allows the LPPP purge system to continue to be credited with preventing explosions in LPPP tanks. Explosions in 512-S are not prevented in the current DSA analysis. The Zone 1 ventilation system is credited in the DSA for the mitigation of onsite consequences, not for the mitigation of offsite consequences.

The DSA DBE analysis (Reference 16) is extremely conservative. According to Reference 27, the sludge IDP appropriate for current operations (Sludge Batch 8) is only 16.1% of the IDP assumed for sludge in Reference 16. The IDPs for other waste streams are expected to be similarly reduced. The DSA reported offsite consequences for the DBE are ≤ 11.5 rem. Per Compensatory Measure 2.2.3, the IDP will be restricted to 20% of the DSA value. The consequences using the new IDP would be about 0.2* 11.5 rem or 2.3 rem. Additional conservatisms present in the analysis include the assumption of multiple participating tanks, the assumption of detonations instead of deflagrations, and the assumption of a stoichiometric hydrogen-air mixture in an empty tank for several tanks. These conservatisms are judged to bring the offsite consequences down to an acceptable level without the need for compensatory measures other than Compensatory Measures 2.2.2 and 2.2.3.

The onsite consequences benefit from the reduction in IDP discussed with respect to offsite consequences, the available Zone 1 ventilation system, which reduces the contribution of the largest contributor to consequences (releases from the vitrification building) by a factor of 200, and Compensatory Measure 2.2.2, which eliminates the contribution of the second largest contributor to consequences (explosions in the LPPP). The analytical conservatisms discussed with respect to offsite consequences also apply to the onsite consequences. As a whole, these systems and conservatisms are judged to

provide adequate margin such that compensatory measures other than Compensatory Measures 2.2.2 and 2.2.3 are not required.

The unmitigated frequency of the DBE is Unlikely (Reference 23). The presence of retained gas does not affect this frequency.

3.1.5 High Winds

As in the case of the DBE, the bounding High Wind scenario involves many sub-events that contribute to the consequences of the over-all event. Because the 221-S process tanks are contained within wind-resistant structures, this event will not cause the agitation required to release retained hydrogen. The LPPP vessels are located below grade and as such are not impacted directly by the High Wind. However, as described in the DSA, these tanks are assumed to detonate in the safety class mitigated scenario. The release of retained gas would increase the calculated consequences for a detonation in the RPT because they are not based on an empty tank, stoichiometric mixture. The calculated consequences from explosions in the SPT and PPT are not affected by the release of trapped hydrogen because they are based on an empty tank, stoichiometric mixture. As mentioned in Section 3.1.3, the consequences of an explosion in the RPT are very small. An increase in those consequences would not result in the over-all unmitigated consequences increasing significantly.

With respect to the contributions from explosions, the safety significant mitigated High Wind scenario includes consequences from 512-S which are identical to those for the mitigated DBE scenario. It excludes contributions from 221-S and the LPPP because of DSA-credited controls. Compensatory Measure 2.2.2 is judged not to be necessary because the safety significant High Wind event will not agitate LPPP tanks.

The unmitigated frequency of this event was determined to be Extremely Unlikely (Reference 23). This frequency is independent of the presence of retained gas.

3.2 Final Safety Assessment

An Unreviewed Safety Question Evaluation (USQE), USQ-WD-2014-00745 (Reference 18), was performed for PISA PI-2014-0013 and resulted in a “positive” evaluation.

The USQE was “positive” based on a “Yes” answer to the following Questions:

1. Increase in probability of occurrence of an accident.

2. Increase in consequences of an accident previously evaluated.

3. Increase in the probability of occurrence of a malfunction of equipment important to safety.

4. Increase in in the consequences of a malfunction of equipment important to safety.

7. Decrease in margin of safety.

The current operational status of the facility is impacted by the Compensatory Measures of this PISA and ESS. As discussed in Section 3.1, the Compensatory Measures discussed in Section 2.2 are adequate to protect the safety basis of the facility until such time that necessary controls have been established.

3.3 Path Forward

1. Implement the Compensatory Measures discussed in Section 2.2.

2. Revise the DWPF Safety Basis (SB) documents to include a discussion of the issue and the documentation of necessary controls.

3.4 Summary of Recommendations and Conclusions

Based on the results of this evaluation, the Compensatory Measures detailed in Section 2.2 shall remain in place until necessary controls have been incorporated into the SB documents. In order to support the milestones for the Alternate Reductant Project, the SB changes for this PISA will be incorporated into the DWPF FY2016 Annual Update, which will be implemented by January 31, 2017.

Ms. Charlene Smith
SRR-CAA-2015-00405
Attachment

ATTACHMENT 4

SRR Safety Document Approval Form

SRR SAFETY DOCUMENT APPROVAL FORM

Safety Document: ☐ BIO/JCO ☐ DSA/SAR/ASAD ☒ Other ESS ☐ TSR

☐ New ☒ Revised ☐ Extended

Document Number, Title and Revision:
U-ESS-S-00001, Rev. 1, ESS: Retained Hydrogen in DWPF Vessels (PI-2014-0013)
U-ESS-S-00002, Rev. 2, ESS: Melter Feed Rate Temperature Correlation Basis (PI-2014-0009)

Nuclear Safety Manager:
T. H. Huff

List of applicable Safety Documents, systems, and other references*
WSRC-SA-6, Rev. 33
S-TSR-S-00001, Rev. 57

Comment:
These revisions allow for the ESS documents to be incorporated into the FY2016 annual Update.

APPROVALS

Organization**	Name	Signature	Date
DWPF FOSC Chairman	W. M. Barnes		11-19-15
DWPF Facility Manager	W. M. Barnes		11-19-15
DWPF Operations Manager	F. D. Vick		11/19/15
SRR Chief Engineer	J. K. Fortenberry		11/19/15
SRR Deputy Project and Operations Manager	~~S. A. MacVean~~ M.A. Schmitz		11/20/2015

* Attach extra sheets as necessary.
** There is no set order of signatures.